The Effectiveness of Using Computer-Assisted Instruction for Reading Intervention on Reading Comprehension and On-task Behavior of Students with Attention Deficit Hyperactivity Disorders in a Second Language Classroom

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Areej A. Ahmed
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This dissertation titled
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by

AREEJ A. AHMED

has been approved for
the Department of Teacher Education
and The Patton College of Education by

Dianne M. Gut
Associate Professor of Teacher Education

Renée A. Middleton
Dean, The Patton College of Education
Abstract

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The Effectiveness of Using Computer-Assisted Instruction for Reading Intervention on Reading Comprehension and On-task Behavior of Students with Attention Deficit Hyperactivity Disorders in a Second Language Classroom

Director of Dissertation: Dianne M. Gut

This study was conducted to investigate the impact of computer-assisted instruction (CAI) on college students’ on-task behavior, and reading comprehension levels who were diagnosed with ADHD in a second language classroom. In addition, a control group of college students without ADHD enrolled in the same second language class were also studied. The purpose of the control group was to determine whether or not students with ADHD achieved the same level of on-task behavior and reading comprehension as students without ADHD through the use of computer-assisted instruction. Moreover, this study investigated participants' perceptions of using CAI to aid in second language learning. The results showed a significant impact of computer assisted instruction as a reading intervention on students’ on-task behavior as well as reading comprehension. Furthermore, interviews with participants revealed positive perceptions regarding the use of technology for college students with ADHD in a second language classroom.
Dedication

To the man who set me free, to my father,

Ahmed Asisri
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I would never be where I am today without the guidance and support of my committee members. Your insight helped me to be a better educator and researcher. Thank you so much for your time. I would like also to thank my students who participated in this study. Thank you for sharing information about yourself and education with me. Your willingness to help made this study possible.

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Background of the Study

Human learning and behavior are related to an individual’s ability to pay attention to the important elements of the environment, recall and preserve information, control, and think critically about learning strategies (Barkly, 2002; Lyon & Krasnegor, 1996; Resnick, 2000). A lack in these abilities can significantly hinder individuals' lives (Lyon & Krasnegor, 1996). Attention deficit hyperactivity disorder (ADHD) is one condition that can result in an inability to learn and behave according to societal norms. ADHD is a developmental neurobehavioral mental health disorder identified during childhood and characterized by inattentiveness, hyperactivity, and impulsivity (Barkly, 2002; Hart, Massetti, Fabiano, Pariseau, & Pelham, 2010; Weiss, Hechtman, & Weiss 1999). The characteristics identified above are also core symptoms of ADHD (Resnick, 2000). Such symptoms interfere with individuals' abilities to solve problems, plan, and handle unexpected situations. For example children with ADHD have a hard time following directions, and completing tasks (Lyon & Krasnegor, 1996; Resnick, 2000).

Core Symptoms of ADHD

Typically, individuals with ADHD show certain pattern of maladaptive behavior that hinder their lives such as, inattention, hyperactivity, and impulsivity.

Inattention. Russell and Barkley (1998) describe inattention, by explaining these individuals "display difficulties with attention relative to normal children of the same age and gender" (p. 57). According to Resnick (2000), inattentive individuals experience difficulties in focusing on one task without being distracted within a few minutes of starting it and tend to leave tasks incomplete due to boredom. Furthermore, inattentive
individuals might work on a task they enjoy, however, without appropriate intervention, it may still be difficult for them to organize the task and learn from the experience. (Resnick) 2000 further stated that individuals with inattentive behavior are often forgetful, have poor skills in time management, organization, and can be overwhelmed in new situations.

**Hyperactivity.** Hyperactivity is defined as an extreme and inappropriate level of motor or vocal activity often characterized by impatience, fidgetiness, and uncontrolled body movements. Usually, such movements are distracting and not related to the given task (Russell & Barkley, 1998). Hyperactivity is usually observed in children as leaving their seat, talking without permission, and making unusual noises (Russell & Barkley). Unlike children, adults exhibit hyperactivity in more adaptive ways. For example, adults might work two jobs, do an outdoor activity, or work for extended hours (Resnick, 2000; Weiss, Hechtman, & Weiss, 1999).

**Impulsivity.** Impulsivity is characterized by a lack of ability to control and manage an immediate response (Weiss, Hechtman, & Weiss, 1999). People who are extremely impulsive face difficulty in limiting their reactions and often react without thinking (Lyon & Krasnegor, 1996; Resnick, 2000). Although impulsivity affects both children and adults, in adulthood this attribute can lead to very serious outcomes. For example, it can lead to an individual quitting a job without having another, showing anger, irritation, or being verbally abusive in the worksite or with children, and engaging in risky behaviors (Weiss, Hechtman, & Weiss, 1999). Unfortunately, because of the negative behaviors associated with impulsivity, impulsive individuals may have difficulty acquiring social skills and dealing with others (Resnick, 2000). Not all individuals who
exhibit the behaviors identified above have been diagnosed with ADHD; however, if these characteristics/behaviors are long term, excessive and persistent, a formal assessment might be needed (Resnick, 2000).

**Adults with ADHD**

ADHD in children has been well studied for decades, but not in adulthood (Davidson, 2008). The prevalence and research data suggested that 4 to 5% of adult males are diagnosed with ADHD in the United States (Montano, 2004). Recent longitudinal studies showed that individuals do not outgrow ADHD and the symptoms of ADHD continue into adulthood. Case studies for adults with ADHD are needed because they show the long-term effect of ADHD on individuals (Fisher, 2007). ADHD effects adults' lives, and often correlates with difficulties in education, job, marriage, and lifestyle (Birchwood & Daley, 2009; Davidson, 2008; Resnick, 2000; Weiss, Hechtman, & Weiss, 1999). Many individuals with ADHD experience academic and social difficulties without knowing the real cause of their deficits (Resnick, 2000).

For many years, the diagnostic criteria suggested by DSM-IV was inappropriate for adults with ADHD (Fleischmann, Erez, & Miller, 2013). Regarding the accuracy of the DSM-IV, Barkly (1998) criticized the wording of the criteria because of its insensitivity to adults. Based on that, it was recommended to carefully apply the criteria when diagnosing adults (Davidson, 2008). A proper diagnosis of ADHD helps individuals develop a better understanding and view of their lives, and overcome their difficulties. Early and appropriate diagnosis allows individuals diagnosed with ADHD to cope with the symptoms and have more positive perceptions of themselves and their abilities (Fleischmann, Erez, & Miller, 2013). At the Mid-Western university where this
study was conducted, 1.87% of undergraduate and graduate students registered with the office of accessibility services have been diagnosed with only ADHD.

**ADHD and Academic Performance**

Many college students are diagnosed with ADHD which can impact their academic achievement. Studies have suggested that college students with ADHD have academic difficulties, for instance, comprehending long reading tasks, taking notes, and organizing their writing assignments (Resnick, 2000; Russell & Barkley, 1998; Wender, 1995). Additionally, learning a second language has been highlighted as one of the difficulties college students encounter in their academic lives (Sparks, Javorsky, & Philips, 2004).

It has been well documented in the literature that inattention, hyperactivity, and impulsivity have an impact on learning during childhood as well as adulthood (Russell & Barkley, 1998). In that regard, several researchers (Pennington & Ozonoff, 1996; Wender, 1995) speculated that poor academic performance is a crucial matter that individuals with ADHD encounter in school. Similarly, Loe and Feldman (2007) found that ADHD is associated with poor academic performance in primary subjects such as math and reading and students with ADHD are more likely to drop out of high school and post-secondary education. Additionally, achievement on standardized tests scores in math, reading, spelling, and reading comprehension indicated that the performance of students with ADHD is significantly lower than their typical peers (Russell & Barkley, 1998) and has a negative impact on academic performance in childhood (Rydell & Yang-Wallentin, 2013).
Stahr and Brenna (2006) reported that students with ADHD display undesirable behaviors that often distract them and therefore impact their own academic performance. For example, failing to follow directions and difficulty in sustaining attention for a long period of time might happen repeatedly in class which can hinder students’ learning and may limit their access to new academic skills.

One critical academic subject that students with ADHD experience difficulty with is reading. Numerous studies indicate that the reading ability of students with ADHD is lower than their peers (Mason, Reid, & Johnson, 2011). Specifically, reading comprehension is an area of difficulty.

The ability to recall information after reading is one factor that impacts the reading comprehension level of students with ADHD (Mason, Reid, & Johnson, 2011; Miller, Betjemann, Willcutt, Pennington, & Olson, 2012; Stern & Shalev, 2012). It has also been suggested that an inability to sustain attention may have an impact on reading comprehension. In their study, Stern and Shalev (2012) examined the relationship between reading comprehension and attention span. Students who were classified as having poor sustained attention earned lower scores in reading comprehension compared to those classified as having good sustained attention. The authors suggested that applying interventions to help students improve their sustained attention might have a direct impact on reading comprehension. Similarly, Joshi, Palmer, Smith, and Kirby (2002) concluded that an inability to sustain attention while reading is the main cause of poor comprehension in individuals with ADHD. Moreover, Sexton, Gelhorn, Bell, and Classi (2011) found that students with ADHD demonstrate significant difficulty in reading comprehension, working memory and sustaining attention.
Reading comprehension is an area of interest for second language learners, and it is essential not only in a first language, but also in a second language. Beatrice and Miculecky (2008) stated the success in a second language classroom cannot occur without acquiring good reading skills in the target language. Lipka and Siegel (2011) found that even though second language learners had high academic achievement, they struggled to obtain similar levels of reading comprehension when compared to native speakers. Zhang and Lawrence (2008) proposed that achieving better reading comprehension is possible when useful strategies are utilized. Moreover, according to Zare (2013) applying effective strategies helps second language learners to achieve appropriate reading comprehension levels and master the target language.

A lack of comprehension and other difficulties students with ADHD experience can be eliminated by utilizing effective academic instruction (Gelhorn, Bell, & Classi, 2011). Self-management, self-monitoring, class wide peer tutoring, and computer assisted instruction are common educational interventions that have been used with students with ADHD to increase their on-task behavior and gain academic skills.

Self-management. According to Dupaul and Hoff (1998), “Self management refers to actions in which an individual takes to change or maintain his or her own behavior” (p. 292). Davies and Witte (2000) reported that students with ADHD usually exhibit disruptive behaviors that influence the learning environment such as disrupting their classmates, and using inappropriate expressions. The authors indicate that using self-management helps students to be aware of their behavior and reduce undesired behaviors associated with ADHD. Similarly, Moore, Dupaul, and White (2006) stated
that self-management has a positive impact on students’ preparation for the classroom and the completion of required tasks.

**Self-monitoring.** According to Nelson and Hayes (1981), self-monitoring is described as:

an individual recording the occurrences of his or her own target behavior. Two stages are involved. First, the person observes his or her own behavior to determine that the specified behavior has occurred. Second, the person records the occurrence of observed behavior. (p. 4)

Friedlander, Frizzelle, Saddler, and Graham (2005) found self-monitoring significantly improved students’ writing skills. Self-monitoring is a functional and practical approach because it helps students identify their weaknesses and gradually improve them.

**Class wide peer-tutoring (CWPT).** Greenwood (1997) describes class wide peer tutoring (CWPT) as “an instructional strategy that is developed to assist teachers to provide special instruction, while providing students with sufficient opportunities to become actively engaged during the instruction” (p. 53). Dupaul, Ervin, Hook and Mcgoey (1998) conducted a study to determine the effectiveness of CWPT for students with disabilities. They found that CWPT was successful in decreasing off-task behavior, and encouraging students to learn from each other in a dynamic environment.

**Computer-assisted instruction (CAI).** CAI is characterized as presenting information via technology in academic settings (Mautone, Dupaul, & Jitendra, 2005). Several studies examine the role of technology in learning. Clarfield and Stoner (2005) indicated that reading programs help students improve their reading fluency as well as on-task behavior. Likewise, Cullen, Sue, Sheila, and Wheaton (2013) investigated the
impact of CAI on learning sight words. They found that students learned more sight words when CAI was used and elevates attention in students with ADHD. CAI can also be used with different content areas as evidenced by Ota and DuPaul (2002) who used math software to improve students’ understanding of math content. Their study found students’ score increased significantly with the use of CAI.

**Statement of the Problem**

Attention deficit disorder is a common disability that can hinder people's social and academic lives (Loe & Feldman, 2007). Educators witness the difficulties experienced by students with ADHD every time they try to focus, complete a task, or even follow directions in class. In order to help these students, research has identified evidence-based practices, such as computer-assisted instruction, peer tutoring, and self-monitoring that have demonstrated positive outcomes for students diagnosed with ADHD. These strategies are employed in classrooms to assist students with ADHD to sustain attention, increase on-task behavior, and improve academic outcomes (Davies & Witte, 2000; Raggi & Chronis, 2006). Based on additional research, an inability to sustain attention continues to be a struggle for college students with ADHD in their post-secondary academic lives. The present study was an attempt to investigate the impact of computer-assisted instruction on off-task behavior, and the reading comprehension of college students diagnosed with ADHD in a second language classroom.

**Purpose of the Study**

The purpose of this study was to examine the impact of computer-assisted instruction (CAI) on off-task behavior, and the reading comprehension level of college students diagnosed with ADHD in a second language classroom. In addition to
investigating the impact of CAI on off-task behavior and reading comprehension, a control group of college students without ADHD who were enrolled in the same second language class were also studied. The purpose of the control group was to determine whether or not students with ADHD achieved the same level of off-task behavior and reading comprehension as students without ADHD through the use of computer-assisted instruction. Moreover, this study investigated participants' perceptions of using computer assisted instruction for reading intervention to aid in second language learning.

**Significance of the Study**

The significance of this study lies in the need for college students diagnosed with ADHD to have access to evidence-based strategies that can help them with reading comprehension in a second language. Numerous studies have demonstrated that students with ADHD struggle with reading comprehension, on task behavior, and language learning (Beatrice & Miculecky, 2008; Ghelani, Sidhu, Jain, & Tannock, 2004; Lawrence, 2008; Lipka & Siegel, 2011; Zhang, 2012; Zhang & Lawrence, 2008). However, there is a noticeable gap in the literature examining the effectiveness of strategies designed to assist college students with ADHD improve on-task behavior and reading comprehension in second language learning. This study aimed to address the existing gap in the professional literature. Moreover, the findings of this study will assist language teachers, special educators, and college students by evaluating the effectiveness of a computer-assisted strategy that can be utilized in learning, whether for reading comprehension in a first or second language.

**Research Questions**

The following questions were designed to address the aim of this study:
1. Does computer assisted instruction for reading intervention increase on-task behavior for college students diagnosed with ADHD?

2. Does computer assisted instruction for reading intervention increase reading comprehension for college students diagnosed with ADHD?

3. Does computer assisted instruction for reading intervention help college students diagnosed with ADHD increase on-task behavior as compared to those who do not have ADHD?

4. a) What are students’ perceptions regarding the use of computer assisted instruction for reading intervention in second language classrooms?

   b) What are the potential benefits and or challenges of using computer assisted instruction for reading intervention in second language classrooms based on students’ experiences?

**Hypothesis**

The hypothesis is that computer-assisted instruction (CAI) will improve the on-task behavior and reading comprehension of college students diagnosed with ADHD who are second language learners, to a greater degree than traditional materials.

**Delimitations and Limitations of the Study**

This study has several limitations and delimitations that should be considered. First, the target population of this study studied Arabic language for two years which might have an impact on their understanding of the language structure. Second, due to the sample size, the findings of this study cannot be generalized to other college students. Furthermore, the observation was done by the researcher, so a subjective perception might impact the results, however a second co-rater was asked to code observations to
limit researcher bias during observations. Finally, the behavior checklist utilized in this study was designed by the researcher for this particular sample. The construction of the tool was discussed with a special education professional with many years of experience in the field of special education and the target behaviors identified were based on characteristics of ADHD identified in the research literature.

**Definition of Terms**

**ADHD.** According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), ADHD is defined as "a persistent pattern of inattention and/or hyperactivity that interferes with functioning or development" (APA, 2013, p. 59).

**Computer assisted instruction (CAI).** An instructional method utilized as a supplement to address the needs of individuals in educational settings (Anderson, 1986). In this study, computer assisted instruction for reading intervention was used to aid students with their reading comprehension and on-task behavior.

**Off-task behavior.** In this study, off-task behaviors included pen tapping, cracking fingers, playing with objects (fidgeting with objects), looking around the classroom, playing with cell phone, daydreaming, and leaving the classroom more than once.

**On-task behavior.** In this study, on-task behavior was measured as an absence of the targeted off-task behaviors.

**Sustained attention.** Sustained attention is the ability to be attentive and focus on an activity or a task for a certain period of time (Perry & Hodges, 1999).

**Second language learner.** A person who is learning a second language to use it social and or academic settings.
Summary

This chapter provided a brief overview of ADHD, core symptoms, prevalence, and characteristics of ADHD in adulthood. Moreover, the impact of ADHD on academic performance and several educational interventions were explained. The statement of the problem and significance of the study were disclosed. This chapter also outlined the research questions and hypothesis. Lastly, the limitations and key terms were defined for the purpose of this study.
Chapter 2: Literature Review

Attention Deficit Hyperactivity Disorder (ADHD) is comprised of three main behavioral domains: inattentiveness, hyperactivity, and impulsivity that impact the lives of individuals diagnosed with ADHD. ADHD is a complicated disorder to diagnose because the characteristics often overlap with other disabilities (Sexton, Gelhorn, Bell, & Classi, 2011). According to Barkley, (1998) ADHD is the most common behavioral disorder reported by teachers. Furthermore, children with ADHD exemplify a diverse population who show substantial differences in the severity of their symptoms, the commonality of such symptoms, and the overlap between ADHD and other disorders (Lyon & Krasnegor, 1996; Russell & Barkley, 1998). Moreover, ADHD is prevalent in the United States, and is the most recurrent reason for referring children to psychiatric and mental health professionals (Russell & Barkley, 1998).

Prevalence rates of ADHD indicate 5.3% of young people and 2.9% of adults are affected worldwide (Barkley, 1998). Therefore, understanding the nature of ADHD allows clinicians, educators, students, and families to deal with such a common, yet complex disability. Furthermore, knowing the disability, its causes, symptoms, and treatments helps people diagnosed with ADHD and their families to cope.

In this chapter, research is reviewed with respect to the definition, prevalence, and characteristics of ADHD. Moreover, outcomes of empirical studies regarding educational interventions for ADHD are reported. Finally, the effectiveness of technology to improve reading comprehension for individuals with ADHD is reported, as well as the impact of ADHD on reading comprehension in second language learners is explored.
Definition of ADHD

Attention-deficit hyperactivity disorder (ADHD) has become one of the most widely diagnosed disabilities across all age groups of children and adults (Elder, 2010). Even though a great deal of literature has defined ADHD, it is still hard to obtain a clear, professional, and inclusive definition of ADHD (Barkley, 2002). ADHD has been identified as “a neurobehavioral, developmental, and behavioral disorder that is diagnosed in childhood” (Barkly, p. 12). Birchwood and Daley (2009) state that in the past 20 years there have been improvements in the understanding and awareness of ADHD among educators, professionals, as well as parents. They also support the current understanding that children with ADHD do not outgrow ADHD when they become adults. Indeed, an awareness of ADHD and its influence on adulthood has led clinicians and patients themselves to recognize ADHD as a legitimate disability in adulthood (Levin & Kalbag, 2005).

The Diagnostic and Statistical Manual of Mental Disorders (DSM-V) Definition

Identified as a psychological disorder, the diagnostic criteria for Attention Deficit Hyperactivity Disorder have gone through several changes in the Diagnostic and Statistical Manual of Mental Disorders (DSM). Resnick (2000) summarized the changes made to the concept and criteria of ADHD from DSM, DSM-II, DSM-III, and DSM-IV.

- In 1952, DSM was described as "minimal brain damage".
- In 1968, DSM-II used the term "hyperkinetic reaction of childhood and adolescence” after a professional opinion emerged and disapproved the use of minimal brain damage to describe behavior difficulties.
c) In 1970s, DSM-III amended the old term to: Attention Deficit Disorder with Hyperactivity, Attention Deficit Disorder without Hyperactivity, and Attention Deficit Disorder residual type in adulthood.

d) In 1994, DSM-IV recognized all the attention deficits as hyperactive. ADHD primarily the inattentive type, and ADHD primarily the hyperactive-impulsive type were introduced.

e) In 2000, DSM-IV-TR there was not a clear criterion for adults. The criteria that were listed targeted school-age children and for a long time it was believed that everyone outgrew ADHD, but now the evidence-based practice research shows a growing number of adults with ADHD.

f) In 2013, DSM-V divided ADHD symptoms into “two categories of inattention and hyperactivity and impulsivity that include behaviors like failure to pay close attention to details, difficulty organizing tasks and activities, excessive talking, fidgeting, or an inability to remain seated in appropriate situations” (p. 31). It also provided a formal definition of ADHD as "characterized by a pattern of behavior, present in multiple settings (e.g., school and home), that can result in performance issues in social, educational, or work settings" (p. 31).

**Prevalence of ADHD**

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the disorders that affect 3–5% of school-aged children (American Psychiatric Association, 1994). It is estimated that at least one child in every education classroom has ADHD (DuPaul & Stoner, 1994). Even though many adults experience the symptoms of ADHD, the disorder has been mostly associated with childhood (Kessler, Adler, Barkley, Birnbaum,
ADHD in adulthood was not the main focus of clinicians and practitioners for decades; however, in the last few years a considerable amount of interest among educators has been directed to ADHD in adulthood (Faraone & Biederman, 2005; Kessler et al., 2006).

The growing interest in adults with ADHD has led many professionals to investigate the prevalence rate of ADHD among adults. Kessler, Adler, Barkley, Biederman, & Greenberg (2006) conducted a national study to determine the prevalence of ADHD among adults in the United States. The research team used the National Comorbidity Survey Replication with a representative sample of 3199 participants aged 18-44 years to gather information about ADHD and other mental health disorders. The response rate to the survey was 70.9%. Results of their study estimated that ADHD is diagnosed at rates of 4.4% to 5% among non Hispanic adults from low socio-economic status in the US. The researchers further suggested that more studies are needed to investigate the persistence and the severity of ADHD in adulthood.

Another study by Montano (2004) reported a prevalence rate of ADHD of 4.5% among adults and suggested that most adults diagnosed with ADHD have either been misdiagnosed or given improper medication for their condition. Although practitioners can use the Adult Self-Report Scale to assess the symptoms of ADHD, lack of appropriate standardized assessment tools for ADHD in adulthood may affect the accuracy of the prevalence rates of ADHD.

**ADHD in Adulthood**

Many studies indicated that individuals do not outgrow ADHD, which impacts their adult life (Birchwood & Daley, 2009; Resnick, 2000). These studies have
invalidated the professional opinion of the 1970s that proposed ADHD was a childhood disorder outgrown in adulthood. Longitudinal studies have demonstrated that the symptoms of ADHD in childhood continue into adulthood and have a negative impact in adults. The last edition of DSM-V addressed people with ADHD beyond childhood, so they can get the medical as well as the educational care they need (APA, 2013).

ADHD has a strong influence on peoples’ life styles, as well as their perceptions of themselves, and how they function in their social lives (Weiss, Hechtman, & Weiss 1999). The roles adults must take in their lives force them to behave according to social expectations, and have more responsibilities. They are expected to be productive members in society. Unfortunately, ADHD might interfere and hinder such an anticipated function. Weiss, Hechtman, and Weiss (1999) articulated that ADHD impacts the function of adults throughout their lives; further, it is crucial for adults to understand the nature of ADHD in order to deal with it successfully.

**Characteristics of ADHD**

Most educators, families, and clinicians agree on the impacts of ADHD. Birchwood and Daley (2009) reiterated the DSM IV-TR definition that the child must show a number of signs of distracted, impulsive, and hyperactive behaviors over a period of six months, prior to the age of seven. These behaviors must have a significant impact on daily routines at school and at home. There are prevalent characteristics that have been identified in the literature as well. For example, individuals with ADHD have difficulty concentrating on tasks, listening when spoken to directly, talking excessively, and other symptoms as noted in the definition above.
ADHD has a noticeable academic and behavioral impact on both children and adults. Daley and Birchwood (2009) conducted a meta-analysis to investigate the impact of ADHD on academic performance. In their review, the investigators found that students with ADHD experience difficulties with self-control, hyperactivity, and attention competence, which interferes with their capacity to obtain essential and vital skills including paying attention to teachers, communicating, and interacting with authority figures and friends. Furthermore, ADHD hinders the learning processes linked with mathematics, language, and the development of the literacy skills.

The co-morbidity (overlapping symptoms) of ADHD with other disabilities has been reported in several studies. Richman (2004) investigated the over-diagnosis of ADHD in children with cleft lip and palate (CLP). The aim of the study was to discover if the characteristics of the language learning was taken into consideration when the diagnosis of ADHD was made. The author proposed that children with (CLP) have language and learning disabilities (LD) that might overlap with the signs of ADHD. However, that does not mean the child with a LD will also be diagnosed with ADHD. For example, students who have language difficulties might struggle with self-control and other behavior disorders. Clearly, the previous symptoms are associated with ADHD. The author supported his argument by conducting a study of 177 children with CLP. The children were also taking medication for ADHD. Participants were monitored by psychologists for learning, attention, and behavior problems. The children were evaluated using a behavior problem checklist and interviews were conducted with their parents. The major finding of the study supports the examiner’s hypothesis, which was that of the original of 32 children with a diagnosis of ADHD, only 31% received the ADHD
diagnosis based on DSM-IV criteria. The majority of the 32 children initially diagnosed with ADHD were then diagnosed with LD (65%). The twenty-one children were diagnosed after that with LD including only five who were also diagnosed with ADHD. Consequently, 16 of the 32 children (50%) originally diagnosed with ADHD were misdiagnosed. The findings of this study support the issue of misunderstandings regarding ADHD that teachers and parents might have and the confusion that may occur in the diagnostic process.

**Characteristics of ADHD in Adulthood**

Numerous studies reported that the characteristics of ADHD in childhood and adulthood are different to some extent (Davidson, 2008; Resnick, 2000; Weiss, Hechtman, & Weiss, 1999).

Weiss and colleagues (1999) suggested certain characteristics that can be observed by individuals with ADHD or others around them to include: a) restlessness, b) difficulty in sustaining attention, c) forgetfulness, d) disorganization, e) anger issues, and f) impulsivity. The researchers added other characteristics that DSM-IV did not list as diagnostic criteria such as, "procrastination, low tolerance of frustration, mood lability, low self-esteem, and impairments of social skills" (p. 17-21). In respect to the attributes of ADHD in adulthood, Resnick (2000) argued that inattentiveness is not as obvious as it is in childhood because adults are not always required to sustain attention for a long period of time. However, Resnick agreed that adults with ADHD have difficulty remembering details of particular situations. Furthermore, adults with ADHD have problems with working memory that go beyond forgetfulness (Lyon & Krasnegor, 1996; Resnick, 2000).
Academic Performance and ADHD

Research has shown that academic difficulties are well recognized and documented in individuals with ADHD (Currie & Stabile, 2006; Scholtens, Rydell, & Yang-Wallentin, 2013). Poor academic performance has been reported as one of the most notable difficulties individuals with ADHD face during their academic lives (Pennington & Ozonoff, 1996; Wender, 1995) and several studies have shown that students with ADHD have poor academic skills that effect their academic achievement when compared to their peers without ADHD.

Scholtens, Rydell, and Yang-Wallentin (2013) conducted a study to examine the long-term effect of ADHD on academic achievement. Data was collected over a seven-year period with the same sample of 192 students. The first data was collected when students were in sixth grade, and five years later another set of data was gathered. The last data collection was completed when students were in twelfth grade. For data gathering, teachers completed a survey about their students and their academic standing. As a follow-up study, the same sample of teachers who had been teaching the students since they were in fourth grade were asked to complete another survey to report the students’ progress. Findings indicated that the symptoms of ADHD continued to have a negative impact on students’ academic achievement from childhood through elementary school. The findings of this study support Loe and Feldman’s (2007) conceptual framework of ADHD and its characteristics. They stated that ADHD is linked to poor academic performance in math, reading, and writing among students with ADHD. Moreover, the impact of ADHD may increase the dropout rate among high school students and those in post-secondary education.
Although students with ADHD have average to above average intellectual competence, they struggle academically (Currie & Stabile, 2006). One of the challenges students with ADHD struggle with is working memory (Pennington & Ozonoff, 1996). In that regard, Gropper and Tannock (2009) examined the relationship between working memory and academic achievement in college students with ADHD. In their study, 46 college students (24 males and 23 females) whose ages ranged between 19 to 34 years completed a number of assessments of their auditory-verbal working memory. During one two-hour session, participants completed the Digit Span subtest, Letter–Number Sequencing, the Paced Auditory Serial Addition Test, Adult ADHD Self-Report Scale (ASRS-v1.1), and self-reported GPA. The results indicated that the mean score of ASRS showed a significant level of disturbed behavior compared to the control group. Furthermore, the mean scores of the Letter-Number Sequencing test showed poor performance in students with ADHD. Finally, the study concluded that students with ADHD were struggling with the assessments and did worse than the control group overall.

Besides the academic struggles that students with ADHD experience, they suffer from many behavioral and emotional difficulties that may affect their learning and social life in general. Alongside academic underachievement, Stahr, Lane, and Fox (2006) stated that students with ADHD exhibit behaviors such as failing to follow directions and difficulty in sustaining attention for a long period of time. These behaviors have a negative impact on students’ learning experiences and may limit them from gaining new skills in the classroom. One of the most common behavior problems that students with ADHD experience is off-task behavior (Gürkan, Bilgiç, Türkoğlu, Kılıç, & Aysev, 2010).
In response to these well-documented struggles, a number of studies have been conducted to find strategies that can decrease off-task behavior for students with ADHD.

**Common Educational Interventions for Students with ADHD**

ADHD is a serious concern among educators and families and in response they are looking for effective treatments for children with ADHD. Therefore, researchers and clinicians have investigated a range of interventions. Some of the most common treatments are stimulant medications, clinical behavior therapy, and classroom behavioral interventions (Raggi & Chronis, 2006). In this review of literature, a number of academic interventions with demonstrated effectiveness for helping individuals with ADHD to overcome learning, emotional, and social difficulties are reviewed including self-management, self-monitoring, peer-tutoring, and computer assisted instruction (CAI) for reading intervention.

**Self-management.** The literature reports a number of studies focused on self-management as a behavioral intervention for children with ADHD. According to Dupaul and Hoff (1998) “Self management refers to actions in which an individual takes to change or maintain his or her own behavior” (p. 292). Davies and Witte (2000) reported that students with ADHD usually exhibit multiple behavior problems that influence the learning environment such as disrupting their classmates, and using inappropriate expressions. The researchers selected inappropriate verbalization as a target behavior they wanted to reduce by using a self-management approach embedded with a group contingency. The rationale behind the use of a group contingency system was to have a common goal that all students wanted to achieve. An ABAB design was used to
determine the effectiveness of the self-management intervention. Findings indicate the selected intervention directly reduced the target behavior of children with ADHD.

A similar result was reported regarding the positive influence of a self-management strategy. Dupaul and Hoff (1998) conducted a study using a self-management intervention to decrease disruptive behavior in the regular classroom. Findings indicate that self-management is an efficient approach for controlling disruptive behavior in the classroom setting. Additionally, the results showed that self-management can be used in elementary classrooms where students were able to evaluate their behavior and improve it with the support of teachers and parents.

Utilizing self-management strategies have a significant outcome not just for children with ADHD, but also with adolescents. Moore, Dupaul, and White (2006) applied a multiple-baseline design to assess the consequences of using a self-management strategy to improve the classroom training abilities of high school students with ADHD. The participants in this study were three high school males known for their lack of preparation and unfinished assignments in most of their classes. The result of the study supports the use of self-management as it had a positive influence on improving students’ preparation for the classroom and the completion of their required tasks.

A case study by Shapiro, DuPaul, and Bradley (1998) confirms the importance of self-management. In their study, the examiners adapted a self-management procedure to teach students how to develop a self-management skill that would help them to evaluate the quality of their own behavioral responses and how their teachers perceive their behaviors. The participants were two sixth grade students identified with learning disabilities and ADHD. Direct observation indicated these students exhibited a lack of
attention, had difficulty following teachers’ instructions and struggled with task completion. Furthermore, it was reported the participants displayed inappropriate behavior during class.

The results showed the participants’ behavior gradually improved during the teacher management phase and was continued at or above this level during the matching condition. Moreover, findings illustrated that students’ behaviors went beyond the cumulative mean performance of randomly chosen peers. The study demonstrated the usefulness of a self-management strategy; however, the examiners did not clearly identify the origin of the inappropriate behavior; whether it was attributed to the learning disabilities or their ADHD.

**Self-monitoring.** According to the Center of Early Education and Development (2009),

Self-monitoring involves having a student keep track of his or her behavior.

During research involving students monitoring their own behavior, it has been observed that subjects alter their behavior simply after consciously keeping track of it. One reason for such change is that self-monitoring helps decrease impulsive behavior by training the student to be aware of his or her behavior. (p. 1)

Educators and researchers have investigated the impact of using self-monitoring for students with ADHD and have demonstrated the effectiveness of this strategy (Harris, Friedlander, Frizzelle, Saddler, & Graham, 2005). The researchers selected six elementary children diagnosed with ADHD to determine the effect of a self-monitoring intervention on on-task behavior in the general education classroom. The researchers used a multiple-baseline design that showed improvement in students’ behavior,
academic performance, and productivity. Moreover, the researchers stated that on-task behavior improved by 30% using the self-monitoring approach. In addition to determining the effectiveness of self-monitoring on students’ behavior, the study examined the use of self-monitoring with students with learning disabilities, specifically, students who struggle with writing. They found that self-monitoring increased student learning and they became more aware of their writing problems. The study recommended teachers consider students' needs and goals prior using a self-monitoring strategy. Furthermore, the researchers clearly stated that what works for one student may not work with another. Therefore, teachers should decide what strategy is best for each individual student. Self-monitoring appears to be a functional and practical method because it helps students to diagnose their weaknesses, work on them, and improves their overall performance. Self-monitoring teaches students how to evaluate and manage their behavior.

**Class wide peer-tutoring.** Peer tutoring is a method that allows students to work in pairs and one-on-one where they can gain and learn more than if they work individually (Raggi, Andrea, & Chronis, 2006). By contrast, Greenwood (1997) describes class wide peer tutoring (CWPT) as “an instructional strategy that is developed to assist teachers to provide special instruction, while providing students with sufficient opportunities to become actively engaged during the instruction” (p. 53). Greenwood (1997) indicates that teachers play the main role in effectively applying CWPT processes. The teacher divides the students into tutoring pairs where they can work together toward a mutual goal. This strategy was designed to increase the academic performance and
social interaction among students, especially with students who have learning and behavior difficulties.

Greenwood (1997) stated CWPT should replace traditional teaching strategies such as lecturing and seat work because CWPT helps students to enhance their learning by sharing their knowledge and practicing it with others. Greenwood also claimed that CWPT has shown significant effects with students including increased classroom engagement, decreased the number of students identified with special needs, and decreased the school dropout rate.

The effectiveness of CWPT was examined by DuPaul, Ervin, Hook, and Mcgoey (1998). The researchers used CWPT with 18 students identified with ADHD and 10 typically developing peers from a general education class. The study concluded that the use of CWPT led to decreases in off-task behavior and improvement in academic productivity.

Likewise, DuPaul and Weyandt (2006) identified Class Wide Peer Tutoring (CWPT) as one of the peer tutoring models used to enhance students’ achievements at different levels in a variety of subjects such as math, reading, and spelling skills. They analyzed a number of statistical studies that investigated the effect of CWPT on students with ADHD and their performance and behavior in educational settings. Results showed that after the implementation of CWPT, dynamic and active participation of students with ADHD was significantly improved by as much as 20%. In addition to increases in students’ performance, the off-task behavior of students with ADHD was remarkably reduced. These improvements demonstrate that CWPT has a positive impact on academic performance and a reduction of adverse behaviors. The positive outcomes of
implementing CWPT should encourage teachers to utilize it in the classroom for students with and without disabilities. Raggi (2006) stated the major advantage of using CWPT is to implement it with all students without selecting individual students which might give them a social label among their peers.

**Computer-assisted instruction (CAI).** According to Mautone, Dupaul, and Jitendra (2005), CAI is an instructional method that presents information via technology in educational settings. Furthermore, CAI gives students an opportunity to develop and improve their performance based on direct feedback. Mautone et al. designed a study of three students with ADHD to investigate the effect of CAI on mathematics performance and classroom behavior. Math Blaster software was used to help students improve their math skills. The Math Blaster software presents math concepts in a game format where students can obtain points and move to the next level. The students have to answer the questions correctly in order to go to the following level and if the answers are incorrect, the software gives students feedback and allows them to do the task again.

The Behavioral Observation of Students in School (BOSS) was used to observe students' on-task and off-task behavior (Mautone, Dupaul, & Jitendra, 2005). The researchers used BOSS to report how many times the students were off-task as well as the amount of time they spent on mathematics tasks. The researchers found that CAI had an immediate impact on student behavior. Participants were more engaged and interested in the given task compared to the traditional method of working on math problems. Additionally, the intervention gradually improved students' academic skills in mathematics.
Another study focused on the subject of mathematics was conducted to measure the usefulness of using CAI in a math class. In this study, Ota and DuPaul (2002) used CAI as a supplemental instruction material to assist students in gaining a better understanding of math as well as improve their task management skills. The participants were three students from fourth, fifth, and sixth grade diagnosed with ADHD. The data collection during the observation baseline was done in the regular classroom settings for two weeks. After baseline, the Math Blaster software was introduced to students in the experimental condition. Math Blaster is an online mathematics software that can be utilized with children ranging from 9 to 11 years. It offers thousands of different math problems. Moreover, the program provides tips and rewards for passing from one level to another which help students with ADHD stay motivated and engaged in the target behavior.

In the intervention baseline, students were allowed to work on their computers three times a week for twenty minutes to answer math questions. The study found that the mean score of on-task behavior increased from 81% to 88% for the first participant, 40% to 68% for the second, and 92% to 98% for the third. The findings also indicate that all students experienced a significant improvement in their performance on math problems. Despite the fact that academic improvement varied among the participants, the accuracy of responses increased.

The use of technology across the curriculum has demonstrated benefits for students with and without disabilities. Clarfield and Stoner (2005) investigated the effectiveness of reading CAI programs as an intervention for oral reading fluency and on-task behavior of first grade and kindergarten students with ADHD. The participants were
three males formally diagnosed with ADHD. One of the students was not taking medication for ADHD, but two of them were taking it at the time of the study. The researchers used a multiple-baseline design to evaluate the reading fluency before and after the use of Headsprout, a CAI that provides interactive online lessons for beginning readers. The software offers phonetic-based lessons for young children. When the intervention was introduced, the students were asked to complete 25 lessons on Headsprout. According to the results, students achieved higher scores in words read correctly and reading fluency following the intervention leading researchers to recommend the continued use of CAI reading programs. In addition to improvements in reading, students’ on-task behavior increased from 30% to 70% when CAI was used. The results indicated that CAI helps students with ADHD to sustain their attention which may have an effect on their academic skills.

Correspondingly, Cullen, Sue, Sheila, and Wheaton (2013) conducted a study to determine the impact of CAI on sight word acquisition for fourth grade students with mild intellectual abilities, learning disabilities, and ADHD. The Kurzweil 3000 reading software is a program designed to help students with reading, decoding, and converting written text to speech. It also provides activities and immediate feedback to students. A multiple baseline design was used with four African American students diagnosed with mild disabilities to demonstrate the effectiveness of CAI on sight word acquisition. After a few weeks and the establishment of an observational baseline, students were asked to practice sight word activities for seven sessions. Each session lasted twenty to twenty five minutes. The results indicated that students’ acquisition of sight words increased from 60% to 100% for all students.
CAI as a form of assistive technology. The importance of assistive technology (AT) for students with disabilities has been recognized in the legislation and special education laws in the United States since the 1980s (Edyburn, 2004). The Technology-Related Assistance for Individual with Disabilities Act of 1998 defined AT as “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that issued to increase, maintain, or improve functional capabilities of individuals with disabilities” (Edyburn, 2004, p. 16).

Educators and administrators view assistive technology as a tool that leads students with disabilities to success (Bausch & Hasselbring, 2005; Edyburn, 2006). A large amount of research has been conducted to measure the impact of assistive technology in the classroom and how AT can be effectively integrated into the general curriculum. It has been demonstrated that students with disabilities can be as successful as their peers when the educational system provides the accommodations they need (Edyburn, 2004). For example, if schools adapt the general curriculum using assistive technology, whether it is hardware or software, students with disabilities are given the opportunity to participate in the general education curriculum. More specifically, technology supported educational settings have had a remarkable influence on students who experience reading difficulties, speech, hearing and vision impairments, and behavioral disorders regardless of their age or educational background (Engstrom, 2005). Similarly, Reisberg (2009) stated that a number of studies have shown that 30% of students in public schools cannot read at grade level. This lack of reading ability can result from different factors, including disability, insufficient instruction, and lack of motivation. Reisberg proposed that teachers are faced with a challenge to accommodate
struggling readers so they understand their reading materials and the use of assistive technology can be one tool used to help students improve their reading comprehension.

In recent years, CAI has emerged as one type of technology that can be employed to enhance student learning. In many studies related to special education, CAI has been described as one method, among multiple ways, to deliver information to students with special needs (Blackhurst, 2005; Blackhurst & Lahm, 2000; Rose & Meyer, 2000).

Consequently, several researchers have investigated the significance of using CAI to promote the learning of individuals with special needs. Stetter and Hughes (2011) designed a study to measure the effectiveness of using story maps on a laptop for students with learning disabilities (LD) who struggle with reading skills. Twenty-nine high school students with LD participated in the study. Prior to the intervention phase, the researchers conducted two training sessions to teach students how to design a story map on their computers. After finishing the baseline phase that took eight weeks, students were given three reading passages and were asked to design a story map on the computer to describe the main elements of the story. After the experiment was completed, the researchers asked students about their perception of the story map.

The findings showed that not all students benefit from the use of CAI; however, some increased their reading comprehension scores by 12 to 18 points as measured by the Gates-MacGinitie comprehension subtest. In terms of students’ perceptions, the survey demonstrated that students enjoyed working on the computers. Furthermore, it was easier to follow the directions on the computer than following teachers’ instructions because they could go back to the directions as needed.
In a similar study, the efficacy of an iPad application to improve basic math fluency was examined by O'Malley, Jenkins, Wesley, Donehower, Rabuck, and Lewis (2013). The study was conducted in a special education school that serves students with moderate to severe disabilities including but not limited to intellectual disabilities, emotional disabilities, learning disabilities, and traumatic brain injury. Ten students with autism or multiple disabilities received iPads to use in their math class. Students were able to utilize iPads for two weeks for math instruction. After two weeks, the intervention was withdrawn.

Based on visual and statistical analyses, students with moderate to severe disabilities in the study earned a better math scores when the iPad math application was used. When the intervention was removed, students’ math scores decreased significantly to baseline levels. Moreover, teachers stated that students were enthusiastic to do their math activities using the iPad. In addition to demonstrated effectiveness across content areas, as stated earlier, technology can also be effectively utilized with students of different ages.

Fuchs, Hamlet, Powell, Capizzi, and Seethaler (2006) carried out a pilot study to evaluate the impact of CAI in enhancing addition math skills among at risk students (i.e., reading and math disabilities). Additionally, the researchers attempted to examine the impact of CAI on spelling skills. Prior to the data collection, teachers were asked to rate students based on standardized test scores as well as classroom performance as compared to their peers. The participants in this study were 33 first grade students; half assigned to work on math with CAI and half assigned to work on spelling for five weeks. The results of the study indicated a significant difference between students’ scores during the
baseline phase and the intervention phase. Furthermore, Fuchs (2006) suggested that early intervention could affect students’ development in basic academic skills.

**Computer-assisted language learning (CALL).** According to the U.S. Department of Education (2000), the availability and low cost of advanced technology, including computers and software, makes technology an important part of classrooms in America. Computers and the internet culture play an essential role in today’s education system and technology is utilized with students of different age groups from K-12, as well as those in higher education (Saxena, 2000). The notion of technology usage has a long history. Salaberry (2001) summarized the findings of empirical studies published in the Modern Language Journal since 1916. The work cited showed that technological methods used for many years in second language learning include phonographs, radio, television, films, and video.

Incorporating technology in pedagogical practice has increased among second language teachers, specifically in the area of Computer Assisted Language Learning (CALL) which is a new movement in second language learning. According to Lai and Kritsonis (2006), CALL has a positive impact in second language learning and improves students’ achievement. Regarding the effectiveness of CALL, Lai and Kritsonis (2006) discussed the advantages that CALL can offer in language learning. They stated that using computers and software learning programs help students access their work at anytime with a lower cost. This independent learning environment allows students more language practice and gives teachers more time to focus on tasks needing the teacher’s assistance, such as oral communication and pronunciation.
Even though teaching pronunciation needs to be monitored by qualified teachers, technology can help students improve their accent in the target language. Computer Aided Pronunciation pedagogy (CAP) was defined by Pennington (1999) as an audio speech analysis system that uses input from a recorder to improve speech of second language learners. CAP can be used in pronunciation instructions.

Utilizing CAP in teaching pronunciation has a number of advantages. Pennington (1999) recommended CAP because it gives immediate feedback to the learner and provides accurate results. Moreover, CAP does not have the limitation that pronunciation tutors might have, such as, mis-hearing or lack of patience. Pennington also asserted that CAP is more advanced than a pronunciation instructor.

Neri, Cucchiarini, Strik, and Boves (2002) also focused on using technology aids for teaching pronunciation. They described how to use computer assisted pronunciation training in teaching pronunciation to second language learners. Most technological software deals with vocabulary and grammar, while little attention is given to pronunciation. Input is one of the most important components of mastering pronunciation. Second language learners must practice their speaking skills by using input devices that can improve their speaking and pronunciation skills. Additionally, Computer Assisted Language Learning programs can provide fun games to learn the language and decrease learners’ anxiety. Using computer assisted class discussion in the second language classrooms is effective for providing an interactive approach that learners can freely use. Students can comment on each other's work and give constructive feedback to improve their writing skills (Levy & Stockwell, 2006).
Hauck, Willingham, and Youngs (1999) reported the importance of integrative technology in second language learning in a college level French course. The course was taken by two different groups under the same instructor, textbooks, and materials. However, only one of the treatment groups participated in Technology Enhanced Language Learning (TELL). The intervention in this study (TELL) was an online interactive software focused on reading and writing in the French language. Hauck, Willingham, and Youngs concluded that students who participated in TELL activities did better than the control group in reading and writing in the French language. Furthermore, the treatment group reported that having the opportunity to practice writing helped to lower their stress and motivate them to finish their reading and writing tasks.

**Reading Comprehension**

Reading comprehension is a complex cognitive skill that goes beyond the ability to answer reading questions and recall information from a written text (Anders, 2002). Comprehension was explained by Harris and Hodges (1995) as attempt to "construct meaning of the written or spoken communication" (p. 39). According to Ghelani, Sidhu1, Jain, and Tannock (2004) reading comprehension is "multifaceted and requires the synchrony of number of reading related processes in order to derive meaning from text" (p. 364).

**Reading comprehension in second language learners.** One field that emphasizes reading comprehension is second language learning and learners in a second language classroom need to acquire reading skills in order to succeed (Beatrice & Miculecky, 2008).
Although several studies have been conducted with respect to reading comprehension in second language learning, reading comprehension remains a dilemma for many learners of English as a Second Language (ESL). Researchers continue to investigate the factors behind good or poor reading comprehension among second language learners.

Lipka and Siegel (2011) designed a study to discover the cognitive factors that impact reading comprehension in English as a second language (ESL) learners. Two groups of thirty 7th grade students participated in this study. The first group was native English speakers and the second consisted of ESL learners. The purpose of the sample was to compare achievement levels of information processing, syntactic, and morphological awareness. The results of the study indicated no significant differences between the groups in their information processing, syntactic, and morphological awareness. Even though the ESL group showed similar performance in the subtests, their reading comprehension for full passages was lower than the English speakers.

Zhang (2012) carried out a study to determine the role of grammar knowledge and vocabulary in reading comprehension among English as a foreign language (EFL) adult learners. The participants were 42 females and 148 males from a graduate engineering program in a Chinese university. All students at the time of the data collection were enrolled in comprehensive English classes where they received eight hours of instruction three times a week in the English language. First, a vocabulary test was given to students, followed by an error correction task, and finally a reading comprehension test. All assessments were completed by the participants in their English classroom. Zhang found that students who had better vocabulary understanding obtained a higher score in reading
comprehension. Further analysis indicated that the correlation between vocabulary and reading comprehension was more significant than the correlation between grammar knowledge and reading comprehension.

A relevant study was done by Zhang and Lawrence (2008) in a secondary school in Singapore to determine the relationship between vocabulary and reading comprehension in a second language. The participants were 37 secondary school students who studied English for six years. Students were asked to complete a vocabulary test. A week later, students were given a reading passage that was followed by different drills to assess their comprehension. A correlation statistics was used and the study concluded that vocabulary knowledge is an indication of better reading comprehension. To enhance reading comprehension, several strategies are available to second language teachers as well as learners.

Zare (2013) used a reading inventory and a reading comprehension test with 42 male and 38 female Iranian EFL learners to determine the frequency of use of reading strategies. Furthermore, the examiner attempted to determine the link between reading technique and reading comprehension achievement. The results of the study showed that based on the Oxford classification, the mean score of the descriptive analysis for Iranian EFL learners was above 3.5 meaning that Iranian EFL learners are considered medium strategy users of language learning and reading comprehension strategies. The results also found a strong positive correlation between using reading strategies and reading comprehension achievement. The researchers encouraged second language learners to utilize appropriate strategies as much as possible to master their target language.
Another effective approach was investigated in Korea. One hundred college students in a Korean university participated in a study designed to observe the effectiveness of using gloss (a short description of the meaning of unfamiliar terms) on their reading comprehension in English. The definition of terms could be given in the first or the target language. Three conditions were provided and students had to choose one condition to use before they read. The first condition was the reading passage with no gloss, the second was reading with gloss in Korean, and the third option was reading with gloss in English. After students decided which approach to use, they took a multiple-choice test to check their reading comprehension. A follow up survey was given about the strategy they used to determine how much it helped them to understand the reading materials. The outcome of the study showed that students who chose to read with a gloss in English scored the highest in reading comprehension. The results of the survey indicated that more than 60% of the participants preferred to have gloss in the second language (L2), which was English in this study. Participants stated that gloss helped them understand the meaning of the reading passage.

Hu and Chen (2010) explored the impact of an interactive reading strategy instruction (IRS) on reading comprehension of EFL learners using 68 high school students in South Taiwan. A pre-test was distributed to students to assess their reading comprehension levels before initiating the IRS strategy. As an intervention, various interactive strategies were used with the participants to help them understand the reading materials including explicit instruction, teacher's modeling, scaffolding, and group discussions. After the IRS, a posttest was given to students to determine if they used the strategies learned in class to comprehend the reading materials. The researchers reported
that students made progress in their reading comprehension which means they applied interactive reading strategies to improve their reading comprehension.

**Reading comprehension and ADHD.** The overlap between characteristics and symptoms of ADHD and reading disabilities is an issue that many researchers have been trying to explain to provide insightful scientific justification and effective strategies to practitioners, educators, parents, as well as learners.

Sexton, Gelhorn, Bell, and Classi (2011) reviewed empirical studies that were conducted from 1999 to 2009 to analyze the co-occurrence of ADHD and Reading Disabilities (RD). The focus of the meta-analysis was to find common characteristics of ADHD and RD, and effective treatments and interventions. Based on the literature, it was found that children with ADHD show the same deficits experienced by children with RD. They both experience difficulties with reading and processing speed in addition to deficits in working memory and attention. Although the cause of the deficits children with ADHD exhibit varied from the cause of RD, they both have a similar impact on reading processing and comprehension. The authors estimated the chance of co-occurrence between ADHD and RD as 15% to 45%. Czamara (2013) proposed ADHD and reading disabilities are comorbid conditions; however, it is complicated to clearly identify the basis of the comorbidity.

Poor reading comprehension is crucial to discuss in students with ADHD because it can have a significant effect on student learning. However, Joshi, Palmer, Smith, and Kirby (2002) believed there must be a clear distinction between reading disabilities and ADHD. The authors used intra-individual differences to report the main cause of poor reading comprehension in students with ADHD and students with RD. After giving
reading and listening tests to fifty second graders with ADHD and RD, the researchers found 20% of students with RD were poor comprehenders because of the complexity of the text and word decoding process. On the other hand, the rest of the sample failed to sustain attention in reading and listening tasks which led the researchers to believe that inability to sustain attention among students with ADHD was the main cause of their poor comprehension.

Miller et al. (2012) used ability to recall information to test reading comprehension of children with ADHD. The participants were twenty-seven young children with ADHD whose reading comprehension scores were compared to twenty-seven students without ADHD. A reading passage consisting of 260 words was given to students followed by a qualitative reading inventory. A statistical analysis found a significant difference between scores for the two groups. Students with ADHD showed a severe deficit in recalling important information from the passage which had an impact on reading comprehension. Even thought they recalled the main ideas, they struggled to retell the whole story.

In a corresponding study by Mason, Reid, and Johnson (2011) the authors selected three white male high school students diagnosed with ADHD who also scored low on a reading comprehension standardized assessment. The study investigated the effectiveness of using the Think Before Reading, Think While Reading, Think After Reading strategy (TWA) on reading recall for students with ADHD. A multiple baseline was used to measure students’ reading comprehension. In the first baseline, students were given five reading passages and asked to read them and retell the information to the instructor. The TWA was introduced to students and they were encouraged to write down
their thinking process while reading the text. The results showed that students achieved better reading scores when they employed TWA. Despite the improvement in reading comprehension, findings indicated students could not remember many supporting details from the reading passages.

The findings of the previous studies indicate potential for improving reading comprehension in students with ADHD; however, they do not provide a solution for helping students to remember important details from their reading. To address this issue, Stern and Shalev (2012) studied the role of attention span on reading comprehension. Forty adolescents were assigned to two groups based on the absence and existence of ADHD. Prior to testing students’ reading comprehension, an experiment was done to measure students’ attention spans by using the Conjunctive Continuous Performance Task (CCPT). During the CCPT, students’ answers were recorded as well as their reaction times. The duration of distracted or off-task behavior was also reported. Following the first phase, the reading comprehension task consisted of eight essays from history books students were using at the time of the study. The reading task was followed by a set of questions to assess students’ comprehension. Stern and Shalev (2012) found that students’ attention span during the experiment had a significant effect on the correct answers. Additionally, the experimental group scored lower on both attention as well as reading comprehension. Therefore, the study concluded a possible relationship between reading comprehension and sustained attention. Moreover, the study suggested that further research is needed to find interventions designed to improve the reading comprehension of students diagnosed with ADHD. Even though the study reported that an inability to sustain attention was cornerstone for many studies to justify reading
difficulties in individuals with ADHD, the literature does not provide enough evidence to confirm that inattentive behavior is a cause of poor reading comprehension.

**Second Language Learners with ADHD**

Students with ADHD struggle academically in math, reading, science, and language learning (Hodge, 1998; Pennington & Ozonoff, 1996; Wender, 1995). Regarding language learning, Leons, Herbert, and Gobbo (2009) stated that learning a second language is a significant challenge that individuals with ADHD face in post-secondary education. Regarding teaching foreign languages (FL) to students with ADHD, Wolinsky and Whelan (1999) repudiated the idea that students with ADHD should be required to enroll in FL classes to fulfill their degree requirements. They further stated that asking students with ADHD to take a FL class is unfair and inappropriate. In contrast, Sparks, Javorsky, and Philips (2004) suggested that college students with ADHD are able to pass enroll and pass FL classes to the same degree as their peers when they have appropriate accommodations.

Sparks and colleagues (2004) conducted a study to examine the age, gender, major, academic achievement, scores of college entrance exam, and foreign language (FL) classroom work of college students diagnosed with ADHD. The sample of this study consisted of 68 college students--twenty-eight males and forty females. All participants were required to finish a FL requirement in order to obtain their college degree. The researchers obtained consent from the students to access their academic records, as well as the accommodations they received to pass the FL requirement. The findings revealed that 37% of the students were diagnosed with ADHD before they attended college, while 63% received formal diagnosis after entering college. Most of the participants were Art
and Sciences majors and 20% of them studied in the College of Business. In terms of academic achievement, the results indicated that students’ GPAs ranged between 2.7 to 3.5. The data from the FL classes showed that 88% of the students received accommodations such as using a computer, tapes, recording, and extended time for exams, and were able to pass their language requirements. Sparks and colleagues (2004) concluded that college students should receive appropriate accommodations that can help them successfully complete their FL requirements.

Teaching FL to students with ADHD has been supported by different scholars. For example, Ferrari and Palladino (2007) compared the level of reading comprehension in first language (L1) and second language (L2) in two groups of Italian students with ADHD. The participants of the study were one hundred high school students diagnosed with ADHD who were learning English as a FL. Students’ ability in their native language was tested with an Italian reading standardized test. The test intended to measure reading comprehension levels in the Italian language. After the first phase, students were given reading passages in English followed by questions to check their comprehension of the text. The findings of the study indicated that students with ADHD had lower scores in reading comprehension in L1, as well as L2. In conclusion, Ferrari and Palladino (2007) stated that the linguistic problems students with ADHD face in the FL classroom should not prevent them from learning and utilizing appropriate strategies that can help them.

Foreign language learners are encouraged to use different learning strategies to acquire second language skills (Zare, 2013). This also can be applied with students with learning difficulties. Leons, Herbert, and Gobbo (2009) examined effective teaching practices for students with ADHD in a second language classroom. Data was collected
from thirty-three college students who attended Landmark College. Students were studying Spanish as a second language, were enrolled in the class voluntarily, and were not required to take it. The participants were asked to write a learner reflection sheet that described the most effective strategies they used to learn Spanish. The result revealed the usefulness of several strategies such as visuals, repeating information, games, and music. Additionally, students supported the use of assistive technology in the second language classroom because it gave immediate feedback and presented information in a number of ways.

**Summary**

This chapter provided an overview of ADHD, the changes in the diagnostic criteria for ADHD as outlined in the many revisions of the DSM, and the common characteristics associated with ADHD. Moreover, prevalence of ADHD, and attributes were further explored. This chapter presented the social and academic impact of ADHD on individuals. This was followed by the outcomes of using reliable educational intervention with students diagnosed with ADHD in the classroom. Additionally, the role of assistive technology in language learning and reading comprehension was explained. The last section covered the difficulties of learning second language for those diagnosed with ADHD and effective practices to address those difficulties.

Even though the literature regarding reading comprehension and second language learning is growing, there are limited empirical studies documenting effective teaching practices in the second language classroom for students with ADHD (Leons, Herbert, & Gobbo, 2009). Thus, this study was designed to investigate the effectiveness of using computer assisted instruction (CAI) for reading intervention on on-task behavior and
reading comprehension for college students with ADHD who were enrolled in a second language classroom. Moreover, this research included a comparison between groups of college students with and without ADHD who were enrolled in the same second language class. The aim of the comparison group was to determine whether or not students with ADHD would achieve the same level of on-task behavior and reading comprehension as students without ADHD by utilizing computer assisted instruction for reading intervention. The following chapter provides details regarding the methodology and research instruments used to conduct this study.
Chapter 3: Methodology

The purpose of this study was to examine the effectiveness of using computer assisted instruction (CAI) for reading intervention on college students’ on-task behavior and reading comprehension who have been diagnosed with ADHD and were enrolled in a second language classroom. In addition to examining the use of CAI for on-task behavior and reading comprehension, a comparison group of college students without ADHD who were enrolled in the same second language class were also studied. The aim of the comparison group was to determine whether or not students with ADHD achieved the same level of on-task behavior and reading comprehension as students without ADHD by utilizing computer assisted instruction for reading intervention. Moreover, this study investigated participants’ perceptions of using CAI for second language learning. This chapter addresses the methodology used to conduct the research. In addition it presents the (a) research design, (b) study variables, (c) operational definitions of variables, (d) research questions, (e) sampling plan and procedure, (f) instrumentation, including reliability and validity issues, and finally, (g) data collection, and analysis procedures.

Research Design

Multiple baseline design (MBD). As the name indicates, a multiple baseline design (MBD) requires a number of baselines that are established at the same time. After the determination of multiple baselines, the independent variable (intervention) is introduced. A MBD does not demand the withdrawal of treatment. Once the intervention takes place, it cannot be removed. The effectiveness of intervention in MBD is expressed by having more than one baseline and how the intervention impacts each of them. In MBD, the baseline could be a person, behavior, or situation. Similar to an ABAB design,
MBD is a replication design that allows the researcher to establish a functional relationship between the variables (Crano & Brewer, 2002; Franklin, Allison, & Gorman, 1996). The relationship can be measured when the response of the intervention has the same impact across multiple baselines. In a MBD, the researcher introduces an intervention to one baseline at a time. If the researcher observes new changes on the participants that directly receive the treatment, then it is evidence that the intervention is successful.

Since MBD examines the effectiveness of a treatment or an intervention on multiple subjects, a number of researchers recommended it (Crano & Brewer, 2002; Franklin, Allison, & Gorman, 1996; Hersen, 1984) since MBD allows generalizability of the findings to other participants. Unlike an ABAB design, this design works perfectly with irreversible behavior. Therefore, it is suitable for evaluating long-term treatment.

Kratochwill, Kratochwill, and Levin (1992) state that MBD is a flexible design and could be adapted to clinical as well as educational settings. In addition to the advantages of this design, there is one major disadvantage. It is hard to compare independent variables with a MBD and the response to the intervention may vary between participants or behaviors. For example, one participant might be more receptive to the treatment than another.

**Using single-case designs (SCDs) to address causation.** The main goal of single-case designs (SCD) is to determine if the introduced intervention has an impact on the baseline (Kratochwill et al., 2010). The first step that researchers should consider when conducting a study is the research question; an essential step that will determine the methodology. Single subject designs provide sequences of changes on dependent variables by manipulating and controlling the independent variables. Applying SCD
allows researchers to understand the changes that may occur on a target behavior and the effectiveness of an intervention (Franklin, Allison, & Gorman, 1996). Kratochwill et al. (2010) provided guidelines for the type of questions that “SCD can address including:

- If the aim of the question is to examine and explore functional or causal relations of the independent variables on the dependent variables.
- Evaluating the effect of adding another intervention on the dependent variables.
- If the aim of the question is to compare the effectiveness of independent variables on dependent variables.” (p. 3)

In this study, the researcher used a MBD design to determine the impact of Computer assisted instruction for reading intervention (independent variable) on students’ attention span, and reading comprehension (dependent variables).

**Internal validity.** It is important for any scientific research to establish confidence in the results and conclusions of the study. The validity of functional relationships in SCD needs to be as accurate as possible, which can be accomplished by eliminating internal and external threats to the validity. As stated earlier, generalizability is the major external threat in SCD. However, there are a number of internal validity threats that researchers should be aware of, including but not limited to history, maturation, instrumentation, testing, and attrition or research mortality (Crano & Brewer, 2002).

According to Franklin, Allison, and Gorman, (1996), internal validity refers to the degree to which the researcher has sufficiently controlled the variables in the study so any changes in the baseline/dependent variable are directly related to the presence or absence of the intervention/independent variable. Numerous scholars reported the most prevalent
internal validity threats and explained how to diminish them (Barlow & Hersen, 1984; Kennedy, 2005; Kratochwill et al., 2010).

**History.** Some events that happen at the same time as the study or before that can influence the results. Kratochwill et al. (2010) suggested the researcher study the circumstances surrounding the treatment and establish a case that establishes evidence that the intervention is most likely to be the reason behind the changes in the dependent variable. The replication of treatment in SCD decreases the plausibility that external events will impact the study.

**Maturation.** The physical, intellectual, or emotional development processes that happen over time can influence the results of a research study. For example, the participants grow older during a longitudinal study. Repeating the intervention many times will confirm that the effect is not due to maturity and that the treatment is responsible for the change (Kratochwill et al., 2010)

**Instrumentation.** According to Kennedy, (2005) instrumentation effects take two forms that could affect the data. The first is the method that is used to measure the dependent variable and the second occurs if different observers are recording the data.

**Testing.** Testing is a threat to experimental control coming from the awareness that the participant has been selected for testing. For example, the student could answer accurately, or could show a positive behavior toward the observer and behave or respond as he/she believes the observer would expect him/her to respond or behave. Replicating the intervention will allow the researcher to reduce the possibility that testing affected the results of the study.
Attrition. Attrition refers to the dropout of participants from the study or lack of availability in for a follow-up study. For example, in some longitudinal studies, the participants cannot continue to provide data and attrition can have a serious effect the generalizability of the data (Crano & Brewer, 2002).

Data collection strategies. Kennedy (2005) recommended a number of strategies that a researcher may use for collecting data:

- Frequency or rate: "counting the number of times a behavior occurs in a specific period of time" (p. 15).

- Duration: "measuring behavior according to how long it remains" (p. 16). That can be measured as cumulative total duration of a behavior during a treatment session, or the duration of each time the behavior occurs. This technique is appropriate when sessions do not have an equal length.

- Interval recording or time sampling: the "total sessions time is divided into small equal intervals" (p. 216). Measurement can be done in different ways; recording the presence or absence of the target behavior within one interval, and then adding how many intervals contained the behavior. Also, recording the frequency or duration of the behavior within each interval. It is important to select a time interval that will best show the predictable frequency and duration of the behavior.

In this study, the researcher utilized an interval recording form to assess the target behavior.
**Research questions.** The following questions were designed to address the aim of this study:

1. Does computer assisted instruction (CAI) for reading intervention increase on-task behavior for college students diagnosed with ADHD?
2. Does computer assisted instruction (CAI) for reading intervention increase reading comprehension for college students diagnosed with ADHD?
3. Does computer assisted instruction (CAI) for reading intervention help college students diagnosed with ADHD increase on-task behavior as compared to those who do not have ADHD?
   a) What are students’ perceptions regarding the use of CAI in second language classrooms?
   b) What are the potential benefits and or challenges of using CAI in second language classrooms based on students’ experiences?

**Hypothesis.** The hypothesis in this study was that computer assisted instruction for reading intervention will improve the on-task behavior and reading comprehension of college students diagnosed with ADHD who were second language learners, to a greater degree than traditional materials.

**Operational definitions of variables.** The next section provides operational definitions of the study variables.

**Dependent variables.** This study had two dependent variables, on-task behavior and reading comprehension.

*On-task behavior.* For over two decades, the symptoms of attention deficit hyperactivity disorder (ADHD) have been described as “difficulty sustaining attention,
impulsiveness, and hyperactivity” (Barkley, 1997, p. 65). Students with ADHD have difficulties focusing on tasks, resisting distractions, and completing tasks (Murphy, 2005). In this study, on-task behavior was the mediator variable of software on reading comprehension levels.

On-task behavior in this study was defined as the number of times students participated and engaged in the desirable behavior. Examples of on-task behavior include paying attention to the researcher while giving instructions, working on the reading task and answering the reading exercises, using a dictionary to look up unfamiliar terms in the text, asking help from the instructor when needed, and following the directions when reading questions. On-task behavior was coded utilizing a partial interval form. The length of each interval lasted 2 minutes. Using the interval form, the researcher recorded off-task behavior each time it occurred. According to Kennedy (2005) interval recording or time sampling was defined as the "total session time is divided into small equal intervals" (p. 216). Measurement can be done in different ways; recording the presence or absence of the target behavior within one interval, and then adding how many intervals contained the behavior; recording the frequency; or recording the duration of the behavior within each interval. It is important to select a time interval that will best demonstrate the predictable frequency and duration of the behavior.

**Reading comprehension.** ADHD effects students’ reading abilities and contributes to poor reading comprehension (Knapp, 1996). The researcher was investigating whether or not students’ reading comprehension improved using CAI designed to help students focus on the reading task. Measuring student’s reading comprehension was based on the accuracy of their responses following the reading task.
Students’ answers to questions following the reading passages were graded and scored based on the accuracy of their answers. In the first phase, the researcher graded their work whereas during the intervention Moodle automatically gathered students’ answers and provided automated scores for the multiple choice questions.

**Independent variables.** The independent variable in this study was a computer assisted instruction for reading intervention al (CAI) program or "software" that helped students focus on reading and improve reading comprehension. Moodle is an open-source interactive software that can be used in classrooms to develop effective learning. The software allows the instructor to insert text that is appropriate for the students and their ability levels. Moodle offers different features that teachers can utilize in their classrooms. For example, 1) when the reading text is inserted in Moodle, the teacher can highlight different sections with different colors, 2) an audio file can be attached to the reading, 3) an embedded glossary is available that students can access and use to find the meaning of unfamiliar words, 4) students can copy unfamiliar terms and past them into Google to find out the meaning or definition, 5) pictures and short videos can be added to the reading passages, and 6) the teacher can set the program to give students immediate feedback after they answer questions about the content. Overall, Moodle provides a full menu of options that can be utilized to create an accessible learning environment. These features help students with ADHD sustain their attention and engagement on any given task. Using technology-based materials instead of traditional materials are more likely to engage students with ADHD and encourage them to stay on-task, which impacts their attention positively (Mautone, Dupaul, & Jitendra, 2005).
In the first phase, "baseline" students were given reading passages in a hard copy, followed by multiple choice to determine whether or not they understood the text. In the treatment phase, "intervention" students were given access to Moodle where they found reading passages followed by multiple choice questions to determine whether or not they understood the text. Each student used his/her account username and password to access to the software. The reading passages used during the first and second phase were in the Arabic language, as well as the reading questions.

This study measured the effectiveness of using CAI for college students formally diagnosed with ADHD to improve reading comprehension through sustained attention and time on-task. The researcher selected intermediate level reading passages and gave them to students during the language instruction sessions. The reading tasks were followed by reading comprehension activities. In this study, the software was utilized to improve reading comprehension in the target language. The target language in this case was Arabic. Moodle was used to present the reading texts in the target language followed by a number of reading questions designed to improve comprehension.

**Sampling plan.** The sample for this study was students who were enrolled in an intermediate level Arabic language class at a Midwestern university. Two groups of students were recruited for this study. The first group consisted of three college students who have been formally diagnosed with ADHD. The second group consisted of three college students who do not have ADHD. Patton (1990) recommended purposive sampling when the researcher is seeking specific characteristics in the participants. Accordingly, purposive sampling was chosen for three reasons: 1) students had to have completed one year of Arabic language and enrolled in the intermediate level class, 2)
students must have been formally diagnosed with ADHD, and 3) students must have registered with the Office of Student Accessibility at the university to receive accommodations for their disabilities. The comparison group was chosen based on the characteristics of the experimental group and matched in terms of gender, age, and overall academic achievement.

**The researcher.** The researcher taught participants in this study for two consecutive years. Furthermore, she has a background in special education, with a focus on technology-based academic interventions for students with ADHD. Also, the researcher is a second language learner who had to utilize different strategies in order to learn English.

**Participants.** The participants in the intervention group were two males and one female enrolled in an intermediate Arabic class. The students had been formally diagnosed by a psychologist and determined to have the predominately inattentive type of ADHD or combined subtype of ADHD meaning they had a combination of inattentive and hyperactive characteristics. The control group was comprised of two males and one female. The students in the control group did not have ADHD. The students had previously discussed with the researcher (also an instructor in the class) their diagnosis and provided the paperwork for their registration with the Office of Student Accessibility at the university.

**Instrumentation.** The next section describes the instrumentation used for data collection.

*Time on-task.* During the baseline phase, structured observations were conducted to determine distracting behaviors students exhibited while reading that might inhibit
learning (i.e., tapping pencil, hear shaking, cracking fingers, looking around the classroom). The researcher developed a checklist containing common off-task behaviors displayed by the students identified with ADHD. Observations occurred in the natural setting, which was the language instruction classroom. The researcher collected the data with a co-rater and calculated inter-observer agreement to determine the reliability coefficients of the data collection. During the intervention phase, students were observed in a linguistic laboratory and behaviors were video recorded while students were using the software. On-task behavior was measured by determining how often students were off-task.

Off-task behavior was coded utilizing a partial interval form. The length of each interval was 2 minutes. Using the interval form, the researcher recorded on-task behavior each time it occurred. See Appendix A for a sample.

Reading comprehension. Students' answers to comprehension questions after reading the passages were graded and were scored based on the accuracy of their answers. In the first phase, the researcher graded their work whereas during the intervention Moodle automatically gathered students’ answers, and provided automated scores for the multiple choice questions. The essay questions were graded manually during the baseline and the intervention.

Interviews. Semi-structured interviews were conducted with participants after the intervention phase to explore students’ perceptions of the use of CAI in the second language classroom. Semi-structured interviews are a qualitative methodology that uses interviews to collect data from particular groups about things that cannot be easily observed such as feelings, thoughts, and beliefs (Patton, 1990). David and Sutton (2004)
stated that in semi-structured interviews, the researcher does not investigate a particular hypothesis; rather they are used to determine participants’ attitudes and perceptions regarding the research topic. Corbetta (2003) reported that the researcher in the semi-structured interview has an interview guide, with key themes, issues, and questions to be covered. In these types of interviews, the order of the questions can be altered depending on the course of the interview. Semi-structured interviews are left to the interviewer's judgment to decide their language and wording. Additionally, in this type of interview, the researcher is allowed to ask questions that he/she believes are appropriate, as well ask for clarification if needed, and encourage the interviewee to elucidate his/her answer’s (Corbetta, 2003; Gray, 2004). See Appendix B for a list of guiding questions used in the semi-structured interviews.

**Data Collection Procedures**

Following IRB approval, the data was collected at a Midwestern University in the Linguistics Department. The department offers a language laboratory that has a computer for each student. In the lab, the teacher was able to interact with the students via the teacher's console. Moreover, the lab is set up for experimental studies if needed. It has computers, headsets, ceiling microphones, and cameras. Participants were able to access the computer system by using their school ID and password. The timeline for the study was six weeks. Three weeks were used in observation and establishing the baseline, and three weeks were used for the intervention phase. Multiple methods were used to conduct this study. Data collection included observations during the baseline as well as during the intervention phase. Additionally, interviews were used to collect qualitative data from the participants after the intervention phase. The quantitative data was comprised of reading
comprehension scores in terms of accuracy, and observer ratings of frequency of students’ off-task behavior. The qualitative data came from the interviews after the intervention ended.

**Baseline.** The following sections describe the procedures that were employed during the baseline phase of the study.

**Identification of off-task behaviors.** The observation of off-task behavior took place during nine sessions over a period of three consecutive weeks. Structured observations were conducted to determine distracting behaviors students exhibited while reading that might inhibit their learning (i.e., tapping pencil, hand shaking, cracking fingers, looking around class) in the language laboratory.

**Observations of off-task behavior.** The data for this study was coded by the researcher and a co-rater who was a teacher and counselor with experience working with children with disabilities. In order to ensure the validity of the data collection, a co-rater was given a copy of the behavior rubric and the researcher explained the way in which data was gathered to ensure consistency in rating. The co-rater viewed video tapes of the participants and coded their off-task behavior using the same interval recording form. The observation was done at the same time for all participants while they were reading and working on their reading activity during the university class period.

After the observations were completed, the researcher met with the co-rater to compare data and calculate the co-rater percent agreement. The observation phase lasted three weeks. Participants were observed for three weeks during the 45 minute class period. The observation began when students were given the reading passage and ended when they turned in their work to the instructor. Students were given 20 minutes to finish
the reading task and answer the questions. During the observation, the students were told they were being video recorded. The researcher took notes during the observation sessions and also watched the recordings to check the accuracy of her coding.

**Intervention.** The following sections describe the procedures that were employed during the intervention phase of the study.

**Control group.** The control group continued to receive reading passages in hard copy format and turned them in to the researcher on the same day the intervention group submitted their work on Moodle.

**Intervention group.** Following the baseline phase, the researcher arranged a time for the participants in the intervention group to meet in the linguistics laboratory. The intervention was introduced to the participants and implemented for three weeks. During this time, students’ off-task behavior was observed and their reading activities were graded. The reading passages were from the reading book that was used in the Arabic intermediate course. The comprehension questions for the reading activities were taken from the same reading book. The researcher inserted the reading texts and activities in Moodle to provide materials in a CAI format. Each student had his/her personal user name and password to access to the software.

**Interviews.** The researcher developed potential questions to use during the interview which are included in Appendix B. Interviews were conducted with the intervention group to gather their insights and opinions about using CAI. The interviewer emailed the students individually to determine a mutually agreed upon time and place to meet. The interview took approximately one and a half to two hours depending on the conversation and its direction. During the interview, the researcher took field notes and
used a digital recorder to avoid interrupting the flow of the interview with excessive and distracting note-taking.

**Data Analysis Procedure**

The data from this study was analyzed as described in the following sections.

**Observations of off-task behaviors.** Time on-task was measured by decreases in off-task behaviors.

**Reading comprehension scores.** A repeated measure analysis was used to compare student's reading comprehension before and after the treatment. Specifically, a t-test was used to determine whether or not there were significant differences between the control and intervention group. Reading comprehension was measured by calculating the accuracy of answers to the reading comprehension activities. Results were reported using descriptive statistics (e.g., mean, frequencies) and comparisons were made between the control and the experimental group.

**Interviews.** Students’ perceptions regarding the use of CAI in second language learning were explored to determine if CAI helped them focus on the reading comprehension tasks. Responses from the interviews were analyzed using qualitative methods. The qualitative data from the interviews were analyzed using ATLAS.ti, a software package that is used to code and organize qualitative data (Lewis, 2004).

**Visual analysis.** A visual analysis is the traditional process of representing data in a single subject design. It determines if the functional relationships between variables is established. There are three components of visual representation. The first component is the level, which refers to the level of change on the variables from the time a baseline is established to the intervention effect.
The second component is the trend, which demonstrates the changes that occur in the baseline over time. The third component is variability, which refers to the degree the performance changed during each phase. Using visual analysis the researcher determines the immediacy of the changes that happen when the intervention is removed, the relation between the data points in each phase, and the amount of changes in the dependent variables. In this study, visual analysis was used to analyze changes in the data points for off-task behavior between the baseline and intervention phases.

**Summary**

This chapter provided information regarding the methodology of this study, and a brief review of the literature that encouraged the researcher to use this method. Moreover, the procedures for the study were explained in detail. Further, information about the instruments used was presented. Data collection procedures along with data analysis procedures were thoroughly explained. The next chapter elaborates on the results of the study.
Chapter 4: Results

The purpose of this study was to examine the impact of computer assisted instruction (CAI) for reading intervention on college students' on-task behavior and reading comprehension who were diagnosed with ADHD and enrolled in a second language classroom. Additionally, a comparison group of college students without ADHD was used to determine differences in levels of on-task behavior and reading comprehension as compared to the intervention group.

This chapter presents results of the data collection and analysis for this study. Results of the analyses of the data available from observations during the baseline and intervention phases, as well as interviews with the intervention group are presented.

Research Questions

The following questions were designed to address the aim of this study:

4. Does computer assisted instruction (CAI) for reading intervention increase on-task behavior for college students diagnosed with ADHD?

5. Does computer assisted instruction (CAI) for reading intervention increase reading comprehension for college students diagnosed with ADHD?

6. Does computer assisted instruction (CAI) for reading intervention help college students diagnosed with ADHD increase on-task behavior as compared to those who do not have ADHD?

7. a) What are students’ perceptions regarding the use of computer assisted instruction (CAI) for reading intervention in second language classrooms?
b) What are the potential benefits and or challenges of using computer assisted instruction (CAI) for reading intervention in second language classrooms based on students’ experiences?

Participants

Participants in this study were three college students diagnosed with ADHD in the intervention group (Adam, Jude, Kyle), and three college students without ADHD in the comparison group (Eric, Mike, Erin). All names are pseudonyms to protect the identity of study participants.

Adam. Adam is a graduate student diagnosed with ADHD at the age of 10. Adam is studying Arabic to expand his employment opportunities. He studied two consecutive years of Modern Standard Arabic. Adam reported using medication to help manage the symptoms of ADHD when he was in high school and the first two years of college, and then stopped using them.

Jude. Jude is an undergraduate student who studied Modern Standard Arabic for two consecutive years. Jude is interested in pursuing graduate studies in Middle-East studies. She was diagnosed with ADHD in fourth grade and used medications to manage symptoms of ADHD for the first three years. After that, her mother refused any type of medication, and worked with an intervention specialist using behavioral interventions.

Kyle. Kyle is an undergraduate student in the College of Art and Sciences and was studying Arabic to satisfy a college requirement of two years of a foreign language. Kyle was in the second year of studying Arabic at the time of the study. He was diagnosed with ADHD when he was 16 years old. He took medication to manage the
symptoms of ADHD until he was 18 years old when he stopped taking it for financial reasons.

**Eric.** Eric is an undergraduate student in the College of Business, and was studying Arabic to have enough language proficiency to work with companies in the Middle-East. He studied two years of Modern Standard Arabic.

**Mike.** Mike served in Iraq for one year and was not able to understand many cultural aspects of the country because of language barriers. He enrolled in the Modern Standard Arabic class for two years. Mike was also in his second year of Arabic at the time of the study.

**Erin.** Erin is graduate student majoring in public health. Erin's goal is to go to the Middle East and help women who have health problems. She is also interested in supporting children in African countries that speak Arabic, such as Sudan and Egypt. Erin was in her second year of studying Modern Standard Arabic.

In the following sections, the findings of the study will be reported by research question.

**Inter-Observer Agreement (IOA)**

To enhance the reliability of the data collected throughout the observation sessions, the researcher asked a co-rater to watch the taped observation sessions from the baseline and intervention phases to code off-task behavior in each session. The co-rater was a doctoral student studying counseling and mental health. She also has worked with students with ADHD as a counselor and classroom teacher.

After independent coding of off-task behaviors, the researcher and co-rater met to determine the percentage agreement in coded behaviors. The percentage came from the number of agreement between the two raters, divided by the number of both agreements.
and disagreements, and multiplied by 100. The result was 92% agreement between the two raters.

Testing the Research Questions

Research Question 1: Does computer assisted instruction (CAI) for reading intervention increase on-task behavior for college students diagnosed with ADHD?

Question one was answered using quantitative methods as well as visual analysis. To answer this question, a partial interval procedure was used to record data during the baseline and intervention phases. The observation was done in the linguistic laboratory at a Midwestern university in the United States. The linguistic lab is equipped with computers for all students. In the lab, the teacher was be able to interact with the students via the teacher's console. Moreover, the lab was set up for experimental studies if needed. It had computers, headsets, ceiling microphones, and cameras. Students were given a reading task in Arabic and were given twenty minutes to read the text and answer comprehension questions related to the reading passage. Participants in the second language classroom spent 20 minutes per session in the linguistic laboratory being observed. During each observation session, off-task behavior was coded utilizing a partial interval method for ten intervals, with each interval lasting 2 minutes. The participants were observed for six consecutive weeks, each week had three sessions on Monday, Wednesday, and Friday. There were a total of eighteen sessions between the baseline and intervention phases. The observations were done to determine the frequency of off-task behavior students exhibited while working on reading tasks in the Arabic language.

In order to determine which behaviors to observe, the researcher developed a checklist of frequent off-task behaviors displayed by participants. These behaviors were
based on the researcher’s observations of participants during the previous year. The off-
task behaviors targeted for observation included: pen tapping, cracking fingers, playing
with objects (fidgeting with objects), looking around the classroom, playing with cell
phone, daydreaming, and leaving the classroom more than once.

During the baseline phase, off-task behavior was observed during nine sessions
over a period of three weeks prior to the intervention. When the intervention, CAI, was
introduced to the students, off-task behavior was observed for an additional nine sessions
over the course of three weeks during the intervention phase.

After coding students’ off-task behavior, the researcher calculated the percentage
of time off-task as follows. Each 20 minute session was divided into ten intervals of two
minutes each. Each time the student was off-task, the researcher recorded a check mark
on a coding sheet. At the end each session, the researcher counted how many intervals the
student was off-task, and divided the number of off-task intervals by the total number of
intervals in the session, and multiplied by 100. Kennedy (2005) recommended the used of
use of an interval recording sheet divided to small intervals when the observed
behavior(s) occur in high frequency.

**Visual Analysis**

The following section presents the results of the visual analysis of students’ off-
task behavior pre- and post-intervention. The use of visual analysis can help the
researcher to determine the immediacy of the changes that happen when an intervention
is introduced, after the removal of the intervention, the relation between the data points in
each phase, and the amount of change in the dependent variable. In this study, visual
analysis was used to analyze changes in the frequency of off-task behavior at baseline and during the intervention phase.

**Adam.** The results show that Adam's percentage of off-task behavior ranged from 50% to 80% of the time during the three weeks of baseline sessions. Detailed results are presented in Table 1.

### Table 1

*Adam's Off-Task Behavior During Baseline Phase*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Percentage of off-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>One</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>Sixth</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Seventh</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Eighth</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Ninth</td>
<td>60%</td>
</tr>
</tbody>
</table>

See Table 2 for information regarding Adam's off-task behavior for each session during the intervention phase.
Table 2

*Adam's Off-Task Behavior During Intervention Phase*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Percentage of off-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>One</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Sixth</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Seventh</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Eighth</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Ninth</td>
<td>30%</td>
</tr>
</tbody>
</table>

Adam’s off-task behavior during the intervention phase ranged from 10% to 30% of the time during the three weeks of intervention sessions. A visual analysis confirms Adam's off-task behavior decreased from baseline to intervention phase as represented in Figure 1.
Figure 1. Adam's off-task behavior for baseline and intervention phases.

**Jude.** See table 3 for the percentage of Jude's off-task behavior in each session during the baseline phase.

Table 3

*Jude's Off-Task Behavior During Baseline Phase*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Percentage of off-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jude</td>
<td>One</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>Sixth</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Seventh</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Eighth</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Ninth</td>
<td>50%</td>
</tr>
</tbody>
</table>
Jude’s off-task behaviors varied greatly over the courses of the baseline sessions. Jude's percentage of off-task behavior during the baseline phase ranged from 40% to 90% of the time during the 20 minute sessions. Results for Jude related to the intervention phase can be found in Table 4.

Table 4

*Jude's Off-Task Behavior During Intervention Phase*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Percentage of off-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jude</td>
<td>One</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Sixth</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Seventh</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Eighth</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Ninth</td>
<td>20%</td>
</tr>
</tbody>
</table>

As seen in table 4, Jude's off-task behavior during the intervention sessions ranged from 10% to 40% of the time during the observation sessions. A visual analysis confirms Jude's off-task behavior decreased during the intervention phase as represented in Figure 2.
Figure 2. Jude’s off-task behavior for baseline and intervention phases.

Kyle. Data regarding Kyle’s off-task behavior can be found in table 5 for each session during the baseline phase.

Table 5

Kyle’s Off-Task Behavior During Baseline Phase

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Percentage of off-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyle</td>
<td>One</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Sixth</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>Seventh</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Eighth</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>Ninth</td>
<td>80%</td>
</tr>
</tbody>
</table>
Kyle’s off-task behavior was not consistent during the baseline phase and ranged from 50% to 90% of the time during the baseline observation sessions. Table 6 provides information regarding Kyle's off-task behavior in each session during the intervention phase.

### Table 6

*Kyle's Off-Task Behavior During Intervention Phase*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session</th>
<th>Percentage of off-task behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyle</td>
<td>One</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Third</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Fourth</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Fifth</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Sixth</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Seventh</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Eighth</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Ninth</td>
<td>20%</td>
</tr>
</tbody>
</table>

Kyle's off-task behavior decreased in the intervention phase, ranging from 20% to 50% of the time during the intervention observation sessions. A visual analysis confirms the decrease, as noted in Figure 3.
Figure 3. Kyle off-task behavior for baseline and intervention phase

The percentage of off-task behavior during the baseline and intervention phases for the experimental group and control group are reported in Table 7.

Table 7

*Off-Task Behavior for Experimental and Control Group (Baseline and Intervention Phases)*

<table>
<thead>
<tr>
<th>Groups</th>
<th>Participants</th>
<th>Baseline Percentage</th>
<th>Intervention Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Experimental</td>
<td>Adam</td>
<td>50%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Jude</td>
<td>40%</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Kyle</td>
<td>50%</td>
<td>90%</td>
</tr>
<tr>
<td>Control</td>
<td>Eric</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>Mike</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Erin</td>
<td>0%</td>
<td>20%</td>
</tr>
</tbody>
</table>
As seen in Table 7, off-task behavior of students with ADHD decreased after the intervention in comparison to the baseline phase, while off-task behavior of control group remained fairly stable.

Research Question 2. Does computer assisted instruction (CAI) for reading intervention increase reading comprehension for college students diagnosed with ADHD?

In order to answer question two, a paired t-test analysis was conducted. The data consisted of comprehension scores from the questions associated with the readings during the baseline and intervention phases. Results are presented in Table 8.

Table 8

*Reading Comprehension for College Students Diagnosed With ADHD*

<table>
<thead>
<tr>
<th>Moments</th>
<th>N</th>
<th>Sum Weights</th>
<th>27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.592</td>
<td>Sum Observations</td>
<td>178</td>
</tr>
<tr>
<td>Std Deviation</td>
<td>2.831</td>
<td>Variance</td>
<td>8.019</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.635</td>
<td>Kurtosis</td>
<td>1.507</td>
</tr>
<tr>
<td>Uncorrected SS</td>
<td>1382</td>
<td>Corrected SS</td>
<td>208.518</td>
</tr>
<tr>
<td>Coeff Variation</td>
<td>42.956</td>
<td>Std Error Mean</td>
<td>0.545</td>
</tr>
</tbody>
</table>
As the data indicates, the mean of the reading scores in the intervention phase increased by 6.5 points among participants diagnosed with ADHD with a SD of 2.8.

**Supplemental analysis.** Mixed effects analysis of variance testing using SAS 9.3 software and the MIXED procedure, with appropriate blocking upon the replicated observations for each student and interaction effects were utilized. See Table 9 for information regarding the effect of the intervention on the experimental group and between the experimental and control groups.

Table 9

*Effect of the Intervention*

<table>
<thead>
<tr>
<th>Effect</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>1</td>
<td>50</td>
<td>1.07</td>
<td>0.3058</td>
</tr>
<tr>
<td>Pretest</td>
<td>1</td>
<td>50</td>
<td>7.42</td>
<td>0.0089</td>
</tr>
<tr>
<td>Pretest*Intervention</td>
<td>1</td>
<td>50</td>
<td>2.32</td>
<td>0.1338</td>
</tr>
</tbody>
</table>

The analysis revealed that the effect of the intervention between the comparison group and experimental group was not statistically significant $F(1, 50) = 1.07$, $p = 0.305$. On the other hand, the effect of the treatment, specified as each student’s pretest score, was significant $F(1, 50) = 7.42$, $p = 0.008$ and was independent of membership in the intervention or control groups as determined by statistical testing of the interaction effect between the pretest score and the intervention $F(1, 50) = 2.32$, $p = 0.133$. 
Tests of the assumptions of a properly-performed analysis of variance (normality and homoscedasticity of residuals) were conducted using Shapiro-Wilks testing for normality ($W = 0.942, p = 0.012$) and visual inspection of a plot of residual versus predicted values (plot showed no apparent sign of heteroskedasticity). See table 10 for information regarding the results of the tests for normality.

Table 10

*Results of the Tests for Normality*

<table>
<thead>
<tr>
<th>Test</th>
<th>Statistic</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shapiro-Wilk</td>
<td>$W$</td>
<td>0.942 Pr $&lt; W$</td>
</tr>
<tr>
<td>Kolmogorov-Smirnov</td>
<td>$D$</td>
<td>0.111 Pr $&gt; D$</td>
</tr>
<tr>
<td>Cramer-von Mises</td>
<td>$W-Sq$</td>
<td>0.139 Pr $&gt; W-Sq$</td>
</tr>
<tr>
<td>Anderson-Darling</td>
<td>$A-Sq$</td>
<td>0.972 Pr $&gt; A-Sq$</td>
</tr>
</tbody>
</table>

In the next section, reading comprehension scores for each student with ADHD pre and post intervention are described and visual representations can be found in Figures 4 through 6.

Adam. Adam's reading scores showed an immediate effect after the implementation of the intervention as seen in Figure 4. The data points showed an increase in his performance level during the intervention phase, as determined by his reading comprehension scores. The mean score during the baseline phase was nine correct answers and with the use of computer assisted instruction for reading intervention, his mean reading comprehension score increased to 16 correct answers. The
trend for the last four data points in the intervention phase were consistent which indicated a positive effect of the intervention on the behavior. In sum, it can be said that Adam’s reading improved after implementing computer aided instruction as compared with the baseline phase.

![Graph showing Adam's reading scores pre and post intervention.](image)

*Figure 4. Adam's reading scores pre and post intervention.*

**Jude.** As seen in figure 5, Jude's reading scores improved after the implementation of the computer assisted instruction for reading intervention. The data points showed an immediate improvement in his level of performance as measured by reading comprehension scores. The mean score during the baseline phase was eight correct answers, and improved to 15 during the intervention phase. The trend in Jude’s performance was consistent for the last six data points which means that the intervention had a positive impact on her reading scores. The analysis revealed that Jude improved her
reading comprehension scores with the use of computer assisted instruction for reading intervention.

![Graph of reading comprehension scores pre and post intervention.]

**Figure 5.** Jude's reading comprehension scores pre and post intervention.

**Kyle.** As seen in figure 6, Kyle’s reading scores were inconsistent during the baseline phase. He missed two sessions during the baseline phase which had a marked effect on the data points. After the introduction of CAI, the data points showed an immediate increase indicating improvement in his performance as measured by reading comprehension scores.
Figure 6. Kyle’s reading comprehension scores pre and post intervention.

The reading scores for college students without ADHD are illustrated in Figures 7 through Figure 9.

**Eric.** Figure 7 shows Eric experienced steady performance throughout the study. The data points illustrate a consistent level in the number of correct responses to reading comprehension scores across the baseline and intervention phases. Eric achieved a mean score of 18 during the baseline and intervention phases.
Figure 7. Eric's reading comprehension scores pre and post intervention.

Mike. Figure 8 shows some variation in Mike's performance during the baseline phase. His mean reading comprehension score during the baseline phase was 18. During the intervention phase, the first five data points showed a slight improvement with an overall mean score of 19 indicating a slight increase in performance.

Figure 8. Mike's reading comprehension scores pre and post intervention.
**Erin.** As seen in figure 9, Erin’s performance varies across both baseline and intervention phases. The trend in data points showed no pattern in her reading scores during the baseline and intervention phases. Even though the data points did not have a consistent trend, the overall mean of Erin's reading scores was 19 for both the baseline and intervention phases.

![Figure 9. Erin's reading comprehension scores pre and post intervention.](image)

**Research Question 3. Does computer assisted instruction (CAI) for reading intervention help college students diagnosed with ADHD increase on-task behavior as compared to those who do not have ADHD?**

To answer this question, a Wilcoxon rank-sum test was used which is a nonparametric test that can be used instead of t-test (Hajek, 1969). This test was utilized because the data set did not have a normal distribution. The results of the test can be found in Tables 11 and 12.
Table 11

*Wilcoxon Scores (Rank Sums) for Variable Delta Classified by Variable Treatment*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N</th>
<th>Sum of Scores</th>
<th>Expected Under H0</th>
<th>Std Dev Under H0</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>27</td>
<td>1098.0</td>
<td>742.50</td>
<td>57.321</td>
<td>40.666</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
<td>387.0</td>
<td>742.50</td>
<td>57.321</td>
<td>14.333</td>
</tr>
</tbody>
</table>

*Note.* Average scores were used for ties.

Table 12

*Wilcoxon Two-Sample Test Result*

<table>
<thead>
<tr>
<th>Statistic</th>
<th>1098.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Approximation</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>6.1932</td>
</tr>
<tr>
<td>One-Sided Pr &gt; Z</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Two-Sided Pr &gt;</td>
<td>Z</td>
</tr>
<tr>
<td>t Approximation</td>
<td></td>
</tr>
<tr>
<td>One-Sided Pr &gt; Z</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Two-Sided Pr &gt;</td>
<td>Z</td>
</tr>
</tbody>
</table>

*Note.* Z includes a continuity correction of 0.5.

The results indicated there is a significant difference ($z < .0001, p < 0001$) in on-task behavior for college students with ADHD after the intervention was introduced. The significant difference means that the on-task behavior of the individuals in the experimental group (Adam, Jude and Kyle) who had been diagnosed with ADHD, improved to a level closer to those who had not been diagnosed with ADHD. From the
given result, it can be said that CAI helped college students with ADHD to improve their on-task behavior.

**Research Question 4**

a) What are students’ perceptions regarding the use of CAI in second language classrooms?

b) What are the potential benefits and or challenges of using CAI in second language classrooms based on students’ experiences?

The main objective of this study was to determine whether college students with ADHD benefit from the use of computer aided instruction for reading intervention in second language classroom. A second objective was to determine students' perceptions of CAI. This second goal led the researcher to develop a semi-structured interview to explore students’ perspectives of the use of computer assisted instruction for reading intervention.

Semi-structured interviews allow the interviewee to share information that does not necessarily reflect the questions of the interview; however, they provide details and insights into participant's experiences. Moreover, semi-structured interviews are a type of qualitative methodology that uses interviews to collect data from particular groups about things that cannot be easily observed such as feelings, thoughts, and beliefs (Patton, 1990; Seidman, 1998).

Semi-structured interviews were conducted with members of the intervention group to gather their insights and opinions about using computer assisted instruction for reading intervention in the second language classroom. The interviewer emailed the students individually to determine a mutually agreed upon time and place to meet. Each
The interview took approximately one and a half to two hours. During the interview, the researcher took field notes and used a digital recorder to avoid interrupting the flow of the interview with excessive and potentially distracting note-taking.

Students’ perceptions regarding the use of computer assisted instruction for reading intervention in second language learning were explored to determine if computer assisted instruction for reading intervention helped them focus on the reading comprehension tasks. Responses from the interviews were analyzed using qualitative methods. After each interview, the researcher transcribed the interview. Transcribing each interview was done twice to guarantee the accuracy of the transcription. Once the interviews were transcribed, the interview transcripts were coded using ATLAS.ti software. The researcher coded the transcriptions according to themes that emerged from the interviews. After coding the interviews, codes were put into categories, and categories were labeled and organized into themes to represent the nature of participants’ responses. As a result of this analysis, three main themes emerged: (a) general perceptions regarding the use of CAI, (b) strategies and accommodations related to second language learning, and (c) barriers and difficulties associated with using CAI.

**Theme 1: General perceptions regarding the use of CAI.** For the most part, participants supported the use of technology, specifically computer aided instruction, in the second language classroom. They further reported the usefulness of utilizing technology, especially for reading. For example, to the question, "Describe how you feel when you read a long passage using traditional methods versus using technology-based materials" Adam replied,
I find it more easier [sic] to read on my computer because I can look up the words that I need to know; plus online-based materials offer more features such as audio file, I can read and listen to the passage at the same time. Such as, the program we used in our Arabic class I think it was ADHD friendly. For me, it was very helpful.

Kyle had a similar opinion, indicating, "reading from a book…I'm not sure that I really enjoy it." When he was asked his reasons, he said,

It is long and boring. Arabic language is hard, and there are many words that I do not understand, so when I use technology-based materials I can easily find the meaning of unfamiliar words. When I read from a book and I do not understand I just give up.

The researcher asked further about using the dictionary, to which Kyle responded, "I'm sorry, but I just do not do it.” Jude also supported the use of technology, but pointed out a problem that she faced, "I wish I could use my computer or IPhone to listen to the reading passages.” The researcher asked reasons for her preference of listening over reading to which she replied, "Well, I like to read online more than traditional because it is more stimulating; however, over a long period of time I do get more of a headache with technology-based materials."

To determine if technology helped students with their academic skills, the researcher asked, "Do you believe that the use of technology helps you gain better academic skills in college?” Adam replied,

I definitely think technology can help student better grasp the materials they are presented because it gives them more options to understand how they learn, and
what works best for them. Personally, I prefer taking notes on computer because of the information I get down is substantially larger, and online games or activities make it easier to comprehend what I have missed on a worksheet or in a lecture.

Kyle stated that technology helps him not only in his language class, but in most classes. He said "technology for sure helps, it gives me access to unlimited resources." When asked to elaborate, he added "for example, I had to take mathematics class and could not understand many concepts in class, so I looked for it online and got the help I needed."

Jude expressed a hope that one day she could use her laptop in all her classes, she stated that some professors refuse to let her use her computer because it could distract her from the class. She continued,

I understand some professors hate when we use our computers because they think we are going to check Facebook instead of listening; I really do not. I take notes and keep them organized. I downloaded applications that help me in note taking, otherwise my notes are messy.

Taken together, the three participants agreed that technology supported their learning in the second language classroom, as well as in other classes. They pointed out that technology helped them in sustaining attention because it was stimulating and interesting. They also mentioned the usefulness of technology for converting text to audio files, and organization for note taking. For the most part, students believed that technology offered many features that facilitated their learning.

**Theme 2: Strategies and accommodations for second language learning.** The researcher intended to find strategies and accommodations that college students with
ADHD may need to succeed in second language classroom. To achieve this aim, the participants were asked the following question, "What strategies or accommodations can be used in the classroom to make learning a second language accessible for college students with ADHD?" In response Adam answered,

Please let us record classes; use our computers because we are familiar with them.

I am a PC user and our… the language lab computer is Mac; it confuses me. I have to ask how to use it, so I really get my work done on time.

He further added, “Give us different language applications that are user friendly and affordable.”

Jude offered a different set of strategies students might benefit from using.

I think having a mix of notes and worksheet on Blackboard [online courseware system accessible to students], supplemented with a good lecture would cover a lot of bases. In some of my other classes, having mix of daily work and also work you can gradually do over the semester has really worked out for me because it makes me do the reading and contribute to class.

Kyle expressed a view similar to Adam when he indicated, “I would say let me bring my computer because it is less frustrating to me, but my professors do not always allow it, and give us time to take notes in class and during exams." Overall it can be said that even though students had different perspectives and suggestions, they all agreed and held positive views regarding utilizing technology in the classroom.

Reading comprehension is often a struggle for students with ADHD. Russell and Barkley (1998) indicate that reading comprehension rates for students with ADHD are significantly lower than their typical peers. In the current study, the researcher wanted to
determine the strategies college students with ADHD currently used to help them with reading comprehension. Participants were asked, "What strategies do you use to help you improve your second language proficiency, especially reading comprehension?" Adam replied,

I try to divide the reading to small sections, and read them over and over again, and I ask my Arab friends to read it with me. I listen to podcasts online when I can. I have a friend's mom that lives in Dubai now and she sends me newspapers that are in complete Arabic for me to translate.

Kyle had a different approach for improving his reading comprehension, and said, "I read children's books and try to break down the sentences to understand the meaning of the passage. This helps me gain more vocabulary and understand sentence structures." Jude offered another strategy that she uses and indicated,

I have an application called Quizlet. I use it to insert new vocabulary and attach pictures to new words. It makes it easy for me to remember. The more words you know the easier reading will be. Also, I upload audio files to help me with pronunciation.

Adam, Kyle, and Jude identified many useful strategies and accommodations that educators may offer to college students with ADHD, including but not limited to, allowing students to use their computers in class, recording lectures if possible, and giving extra work throughout the semester for more practice. Students also described some strategies they use to help them improve reading comprehension, such as breaking down reading passages, listening to podcasts, and using online applications to learn new vocabulary.
Theme 3: Barriers and difficulties. Students with ADHD are faced with challenges that can hinder their second language learning. To explore those difficulties, the researcher asked, "What are the difficulties or barriers that you face in the second language classroom?" Adam acknowledged his difficulties with studying a second language since he was in high school.

I studied French when I was in high school and was very hard for me because I did not get the help I needed from my teacher. In college, studying a second language is a requirement for my degree, so I have to work hard to achieve a good grade.

Next he was asked, "What makes studying a second language hard?" to which he replied, The rules of the second language, the writing style, the reading. I do not have enough vocabulary to speak in my second language, also, it is expensive to get language learning programs. Honestly, the traditional way of teaching does not work for me. I had a lot of trouble in the beginning with focusing on actually sitting down to learn vocabulary (I still have trouble with this) and putting forth the effort to learn the language. Having to sit for fifty minutes and listening to the lecture in a second language is definitely not appealing to me, giving us some online games is what I look for.

Kyle experienced the same problem that Jude described and indicated, "Focusing is my biggest problem. Sometimes I need to take a break. When I go for a break, I miss important information that I cannot understand in my own."

The participants revealed numerous challenges that faced them in learning a second language and using CAI. The nature of the language, paying attention to the
lecture for an extended period of time, and the cost of language learning applications were the main challenges students experienced.

**Summary**

This chapter reported the findings of this study. It presented in detail, the effect of using CAI for college students with ADHD. A multiple baseline design was used to show differences in participants’ on-task behavior as well as reading scores pre and post intervention. During the baseline and intervention phases, the researcher examined the effect of an intervention across six data points. Crano and Brewer (2002) recommended at least three points to detect changes from the baseline. Visual analysis was utilized to determine the level and trend of the dependent variables. The next chapter will discuss the results of this study and their relationship to findings of previous studies.
Chapter 5: Discussion

This study was conducted to examine the effectiveness of computer assisted instruction for reading intervention on college students' on task behavior and reading comprehension who have been diagnosed with ADHD enrolled in a second language classroom. A comparison group of college students without ADHD was studied to determine variations in levels of on-task behavior and reading comprehension as compared to the intervention group. This chapter discusses the findings of the current study in the light of literature. This chapter also presents an interpretation of the findings related to each research question and links it to the literature. Furthermore, implications, recommendations, limitations and delimitations of the study are elucidated.

Summary of the Study

The purpose of this study was to investigate the effectiveness of computer assisted instruction for reading intervention on off-task behavior, and the reading comprehension level of college students diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) in a second language classroom. In addition to examining the effectiveness of CAI on off-task behavior and reading comprehension, a comparison group of college students without ADHD who were enrolled in the same second language class were also studied. The comparison group was added to determine whether or not students with ADHD would achieve the same level of off-task behavior and reading comprehension as students without ADHD through the use of computer-assisted instruction. Moreover, this study investigated participants' perceptions of using computer assisted instruction for reading intervention to aid in second language learning. In order to conduct the study, a multiple baseline across participant design was utilized. The baseline condition was
established by conducting structured observations for three college students who had been diagnosed with Attention Deficit Hyperactivity Disorder and enrolled in second language classroom. The target behavior was on-task behavior. A partial interval form was utilized to code the absence of on-task behavior with the length of each interval being 2 minutes. The baseline observation lasted for total of nine sessions over a period of three weeks. Participants were observed in the second language laboratory and recorded on video for 20 minutes while working on a reading task using traditional materials without the use of any technology device. After establishing the baseline, the intervention was introduced for nine sessions for a period of three weeks. In this study, there were two dependent variables, on-task behavior and reading comprehension. The independent variable was the computer-assisted instructional program.

**Intervention.** Computer assisted instruction for reading intervention was the intervention implemented to determine its impact on the on-task behavior and reading comprehension scores of college students with ADHD in a second language classroom. Previous studies indicated the positive role of CAI in language learning. For instance, Clarfield and Stoner (2005) stated that reading programs help students improve their reading fluency as well as on-task behavior. Similarly, Cullen, Sue, Sheila, and Wheaton (2013) examined the impact of computer assisted instruction for reading intervention on learning sight words. Their findings showed that students learned more sight words when computer assisted instruction for reading intervention was used and increased sustained attention in students with ADHD.

**Sampling plan.** Three students with ADHD were chosen from an intermediate level Arabic language class at a Midwestern university. All participants studied the
Arabic language for two consecutive years. Each student contacted the language instructor in the first year to discuss his/her needs for special accommodations due to a diagnosis of Attention Deficit Hyperactivity Disorder. Each student presented the instructor with the appropriate paperwork from the Office of Student Accessibility Services at the university. Based on the researcher’s prior knowledge regarding her students’ disabilities, she contacted them during the second year of language study to determine if they were interested in participating in the current study. In addition, the researcher recruited three more students in their study of the Arabic language in the same class to participate as members of a comparison group. They were also enrolled in the class for the second year of language study and had not been diagnosed with ADHD.

**Instrumentation.** The data was collected using different methods, including structured observations, reading comprehension scores, and interviews. Structured observations were conducted to record the frequency of distracting (off-task) behaviors students exhibited while reading that might inhibit learning (i.e., tapping pencil, hearing, cracking fingers, looking around the classroom). Reading comprehension was measured calculating students' numbers of correct responses to comprehension questions following reading passages in the second language. Responses were graded, scored, and compared based on the accuracy of students’ answers before and after the intervention. Semi-structured interviews were conducted with participants after the intervention phase to investigate students’ perceptions of the use of computer assisted instruction for reading intervention in the second language classroom.
Discussion of Findings

In the next sections, the findings of the current study will be interpreted in response to each research question. Next, the results will be tied to the theoretical framework, and current literature. The main purpose of the study was to examine the effectiveness of computer assisted instruction for reading intervention on college students' on task behavior and reading comprehension in the second language classroom. The target language in this study was the Arabic language because it is the language the researcher had been teaching at the university level for the last five years.

**Research Question 1: Does computer assisted instruction (CAI) for reading intervention increase on-task behavior for college students diagnosed with ADHD?**

The findings of this study showed that using computer assisted instruction for reading intervention had a significant impact on the on-task behavior of the three college students with ADHD in this study. Students’ off-task behavior decreased after the intervention, which is this case was computer aided instruction. Adam's off-task behavior prior to the intervention ranged from 50% to 70% while working on his reading using the traditional method without using his smart phone, I Pad, or computer. After implementing the CAI intervention, his off-task behavior declined and ranged from 10%-30% of the time.

A similar result was found with Jude. Her off-task behavior during the baseline ranged from 40% to 90% of the time, whereas after the intervention, it ranged from 10% to 40% of the time.
For the third participant, Kyle, the findings indicated that his off-task behavior ranged from 90% to 50% of the time during the baseline. However, the same behavior ranged from 50% to 20% during the intervention phase.

These results are consistent with findings from previous studies which indicate the positive role of technology use to support students with ADHD. For instance, Mautone, Dupaul, and Jitendra (2005) found that CAI had an immediate positive impact on student behavior. Students were more engaged and interested in the given task compared to the traditional method. Another study conducted by Ota and DuPaul (2002) found that the mean score of on-task behavior increased from 81% to 88 % for the first participant, 40% to 68% for the second, and 92% to 98% for the third participant. Similarly, Clarfield and Stoner (2005) found that when CAI programs are used with students with ADHD, the results indicated that CAI helps students with ADHD to sustain their attention which may have an effect on their academic skills.

**Research Question 2: Does computer assisted instruction (CAI) for reading intervention increase reading comprehension for college students diagnosed with ADHD?**

The results of the current study indicated that the reading comprehension of college students diagnosed with ADHD demonstrated a significant increase in their mean scores after the introduction of CAI. A visual analysis was conducted for each participant to illustrate the improvement in reading scores pre and post intervention. For Adam, the trend in the data points showed an improvement in his level of performance as measured by reading comprehension scores during the intervention phase. A similar result was found with Jude, where the trend in data points showed immediate effects in the level of
performance after introducing CAI. During the study, Jude asked to use her computer and it was permitted. There was a significant improvement in her reading scores pre and post intervention. Kyle also showed a positive response to the intervention. His mean score improved and he attended all the sessions without taking a break in the middle like he did during the baseline.

Numerous studies have been conducted to determine the relationship between a limited or short attention span and reading comprehension. To address this issue, further analysis was conducted between the reading scores of college students with ADHD in this study and those who did not have ADHD. The findings revealed there was no significant difference between the groups post intervention. This led the researcher to conclude that CAI helped students to sustain attention for a longer period of time which had a positive effect on their reading comprehension. Without the intervention, it would be anticipated that students with ADHD would have persisted in their off-task behaviors which would have continued to impact their reading comprehension scores, causing them to academically fall behind their peers without ADHD.

Research has demonstrated that ADHD has an impact on students’ ability to recall information after reading a long text. Specifically, Miller et al. (2012) found that students with ADHD showed severe deficits in recalling important information from reading passages. Students remembered the main idea of the text, but struggled to retell the story. Stern and Shalev (2012) conducted a study to investigate if ADHD has an effect on short attention span and reading comprehension scores. They found that students who had shorter attention spans obtained lower reading comprehension scores. Likewise, Sexton, Gelhorn, Bell, and Classi (2011) reported that children with ADHD exhibit the same
deficits as those who have reading disabilities. With a similar view, the findings of Joshi, Palmer, Smith, and Kirby (2002) supported the previous study. Participants in their study failed to sustain attention while working on reading and listening tasks which led the researchers to believe that an inability to sustain attention among students with ADHD was the main cause of their poor comprehension. Other studies, such as Lyon and Krasnegor, 1996; Barkley, 1998; and Czamara (2013) suggest it is difficult to clearly identify the reason for the comorbidity between reading disabilities and ADHD. They argued that students with ADHD show commonality of symptoms between ADHD and other disorders.

Even though the results of this study support the existing literature in the relationship between attention span and reading comprehension, there is not enough evidence that confirm a causal link between inattentive behavior and reading comprehension.

Research Question 3: Does computer assisted instruction (CAI) for reading intervention help college students diagnosed with ADHD increase on-task behavior as compared to those who do not have ADHD?

The findings of the current study showed that the on-task behavior of the three college students diagnosed with ADHD in this study significantly improved. In the experimental group, Adam, Jude, and Kyle on-task behavior improved in comparison to the baseline.

Even though they did not sustain attention at the same level as students without ADHD, they progressed to some extent. This indicated that computer assisted instruction for reading intervention had a positive impact on students with ADHD, and helped them
to stay engaged in the given task. Increases in on-task behavior with the introduction of CAI was reported by other researchers. For example, Clarfield and Stoner (2005) found that students’ on-task behavior increased from 30% to 70% after using technology in their reading tasks. Likewise, Mautone, Dupaul, and Jitendra (2005) reported that using CAI with students with ADHD had a significant impact on student behavior. Participants were more engaged and interested in the given task compared to the traditional method.

The improvement of students’ on-task behavior was reported in several empirical studies. For instance, Ota and DuPaul (2002) reported that the mean score of on-task behavior increased for each of the participants in their study. For the first student, the score increased from 81% to 88 %, the second participant’s behavior after intervention ranged from 40% to 68%, and 92% to 98% for the third participant. The findings of this question support the notion of using of CAI as a form of assistive technology for students with ADHD (Bausch & Hasselbring, 2005; Edyburn, 2006; Engstrom, 2005; Blackhurst & Lahm, 2000). Findings seem to indicate that technology is an effective tool teachers and learners can employ to provide access to students with disabilities (Bausch & Hasselbring, 2005; Edyburn, 2006).

**Research Question 4:**

a) What are students’ perceptions regarding the use of computer assisted instruction (CAI) for reading intervention in second language classrooms?

b) What are the potential benefits and or challenges of using computer assisted instruction (CAI) for reading intervention in second language classrooms based on students’ experiences?
The analysis of participants’ perceptions regarding the use of computer assisted instruction for reading intervention in their second language learning revealed overall positive attitudes. Adam, Jude, and Kyle believed that technology helped them with their academic achievement because of the additional features that technology-based materials offer. The participants’ impressions in this study are congruent with previous studies that investigated the role of computer assisted instruction for reading intervention in second language learning. For example, Lai and Kritsonis (2006) presented the advantages of using technology in the second language classroom including unlimited access to materials in an independent setting. Correspondingly, Neri, Cucchiarini, Strik, and Boves (2002) indicated technology helps students learn the language in a stimulating environment and eliminates learners’ frustration and anxiety. Participants in this study listed several advantages of computer assisted instruction for reading intervention, and that technology helped them in many ways. For instance, they suggested computer assisted instruction for reading intervention provided an interesting learning approach that students benefit from to maintain their attention for sustained amounts of time, easy access to online dictionaries for unfamiliar terms in the target language, the possibility of converting written text to audio files which helps students alternate between reading and listening, and the features that note taking applications offer which helps students with ADHD to keep well organized notes.

Stetter and Hughes (2011) indicated in their study that not all students with ADHD benefit from the use of technology; however many participants achieved better understanding of their reading after utilizing technology. They also stated that students with ADHD found it easier to follow the directions on the computer because they were
able to go back to the directions as needed. Mautone, Dupaul, and Jitendra (2005) believed that CAI provided students with immediate feedback that helped them improve their performance. In addition to direct feedback, Ota and DuPaul (2002) found that using CAI as supplemental materials motivated students and engaged them in their academic tasks. For the most part, students’ attitudes regarding the use of CAI support what was found in the literature which emphasized the importance of technology in today's classroom. Even though students expressed positive attitudes towards technology, teachers as well as students should be careful of relying too much on technology. Such over-reliance on technology may undermine students’ learning. For example, using Google translator is effective for beginners who are studying Arabic, but students in advanced levels should employ other skills to find the meaning of unfamiliar words so as not to inhibit their learning.

**Limitations**

There are some limitations related to this study that should be considered. First, the target language of this study is Arabic, the complexity of the language structure may have an effect on students' understanding of the reading passages. This limits the generalizability of the findings to other studies using the Arabic language. There is no indication that similar findings would be found in studies involving other languages. Also, students were in their second year of language study. Findings may be different for those just beginning to study a language or those with more language proficiency.

Second, the sample size was very small, so the findings of this study cannot be generalized to all college students with ADHD. Also, the sample size had a direct impact on the statistical analyses that were able to be used in this study.
Third, the observations were done by the researcher, so a subjective perception might impact the results, however a co-rater was employed in coding the observations to confirm the researcher’s coding of off-task behavior and limit researcher bias during observations.

Finally, the behavior rubric utilized in this study was designed by the researcher for this particular sample. The reliability of the tool has been discussed with a special education professional with many years of experience in the field of special education, however, its reliability was not formally tested with multiple samples. Finally, this study was exploratory in nature. There is a deficit in the current literature in that there have not been enough studies regarding reading comprehension in second language learning and ADHD.

**Implications and Recommendations**

The findings of this study demonstrated the effectiveness of CAI use in the second language classroom for three college students with ADHD studying their second year of Arabic.

**Second language learners in higher education.** The impact of ADHD in second language classrooms is very difficult to study, therefore it is often ignored. This study should serve as a call to decision makers, administrators, and educators in colleges and universities in the United States to recognize the need for a supportive and accommodating second language learning environment for college students with ADHD. The results of many studies indicate that ADHD can effect adulthood negatively, and influence individual’s self-esteem and functioning in social settings (Birchwood & Daley, 2009; Resnick, 2000; Weiss, Hechman, & Weiss 1999). Offering an accommodating
environment for college students with ADHD would help them attend better and potentially achieve higher scores in second language classes. With the increasing number of students diagnosed with ADHD enrolling in college, CAI could impact many students enrolled in college programs that require at least two years of foreign language study. In fact, providing appropriate accommodations to college students with ADHD helps them to pass second language requirements to the same degree as their peers (Sparks, Javorsky, & Philips, 2004).

**Issues of misdiagnosis or lack of disclosure in adulthood.** ADHD has a clear impact on adult behavior (Resnick, 2000). However, it does not get same level of attention as ADHD in childhood. Many factors may contribute to this lack of attention. For instance, not all adults are willing to disclose their concerns, their diagnosis, or even undergo a formal assessment to determine if they have ADHD because they may be afraid of the stigma that often comes with a diagnosis. Additionally, adults are not required to disclose their disability which makes it difficult to provide needed accommodations. It may be those who choose to disclose are those with the most extreme cases. It is also a possibility that ADHD is underdiagnosed or misdiagnosed in adulthood.

**Access to technology.** Next, education institutions, including public schools and universities are encourage to provide advanced technology to aid students in learning. In 2000, the U.S. Department of Education issued a statement in support of making technology an important part of low cost advanced technology in classrooms, including computers and a variety of learning software. Teachers are encouraged to utilize computers in language learning to give students unlimited access at the lowest cost possible (Lai & Kritsonis, 2006). In this study, Moodle was utilized to help students with
ADHD with reading comprehension and on-task behavior. The software is free of charge, and cost effective. Moodle helps teachers develop an effective learning environment and creates a collaborative and interactive learning environment for students (Brandle, 2005).

Second language teachers should be encouraged to use online applications that can help students inside and outside of the classroom.

**Professional development.** Based on comments made by participants during their interviews, it is recommended that universities and colleges provide professional development to faculty members on a regular basis, (every five years) to share new or updated laws on serving individuals with special needs, as well as the latest and accommodations and tools that address the needs of students with special needs. Specifically, principles of Universal Design should be infused and utilized in all course development and delivery.

**Availability of CAI in all classrooms.** Next, the benefit of using CAI should not only be confined to language learning classrooms in higher education. Special educators and educators in general can also incorporate technology for students with disabilities in most academic subjects. For example, Fuchs, Hamlet, Powell, Capizzi, and Seethaler (2006) used a CAI intervention to help students with disabilities with their math lessons. The researchers concluded there were significant differences between students’ performance pre and post intervention. A further study by O’Malley, Jenkins, Wesley, Donehower, Rabuck, and Lewis (2013) reported that using an IPad with math applications helped students with moderate to severe disabilities achieve higher scores in math. Finally, integrating technology into the general education curriculum in schools
and higher education gives students with disabilities an opportunity to engage in an effective learning process (Edyburn, 2004; Engstrom, 2005).

Future Research

After conducting this study, the researcher would suggest several recommendations for further studies in the field of second language learning as well as special education. First, a long-term study regarding students with ADHD is needed to obtain a better understanding of the connection between students’ inability to sustain attention and poor reading comprehension in the second language classroom. For example, language teachers in college are encouraged to work with researchers who would like to determine if students’ attention span has a direct effect on reading ability.

Next, a study utilizing a larger sample could help to identify the usefulness of technology for students with disabilities in second language classrooms. However, additional small studies with small samples like the current study are important in helping to build the research base.

Additionally, more studies are needed to investigate the possibility of eliminating off-task behavior among college students with ADHD. The impact of ADHD in adulthood has been reported by many researchers. For instance, numerous studies indicated that individuals do not outgrow ADHD, which impacts their adult life (Birchwood & Daley, 2009; Resnick, 2000). This should highlight the necessity of finding strategies that can help college students and other adults with ADHD.

Next, there is a gap in current literature linking the impact of ADHD on second language learning, particularly reading comprehension. It is suggested that additional research should examine the effect of ADHD on language learning and reading
comprehension in second language learning. Future studies should focus on the role of CAI for college students with other foreign languages. Also, conducting experimental studies with a larger number of participants is recommended. Such studies will help policy makers, language teachers, and special education teachers to find practical solutions for students with ADHD. As noted earlier, the target language of this study was the Arabic language, which is a very complex language. It is recommended that the study be replicated with different languages to determine if findings will be similar across languages. The findings of this study can also assist teachers who teach English to other language speakers. Many young children who are linguistically diverse in the United States could benefit from the use of open source tools.

**Comfort with technology.** In this study, participants were familiar with technology and enjoyed utilizing it in their learning. For future studies, researchers might include non-traditional students who are not as comfortable or as well versed in the use of technology. It was clear from this research that students were able to describe which strategies were useful for them, but they may not use them if it is not easy or convenient to do so. Instructors should discuss with students in their classrooms what kinds of technology they find useful, in order to provide the supports and instruction in the use of technology tools students may need.

Additional research could focus on which technology tools might undermine student learning. For example, using Google translator is a helpful strategy that beginners may want to use to look up unfamiliar words; however, when the learners rely completely on Google translator, they will not use the context to find the meaning of the new terms.
Also, the convenience of technology could prevent people from acquiring necessary basic and advanced skills.

**Conclusion**

The present research examined the impact of computer-assisted instruction on off-task behavior, and the reading comprehension level of college students diagnosed with ADHD in a second language classroom. The results indicate that the three college students in this study benefitted from the use of CAI and it helped them to improve their reading comprehension scores and decreased off-task behavior. Furthermore, participants reported positive attitudes regarding the use of technology in the second language classroom. The findings highlighted the importance of providing an accommodating learning environment for college students with ADHD. Language teachers are encouraged to understand the nature of ADHD and how it effects students in college. This knowledge will help teachers to work more effectively with their students, accept the challenges that students face, and help them to remove unnecessary barriers to learning. In conclusion, the researcher believes that all students are capable of learning as long as the environment allows it. It is the educator’s job to provide an environment that is designed with all learners in mind, so that all students can achieve their full potential.
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Bacon.


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Appendix A: Interval Recording Form

INTERVAL RECORDING OF TIME ON TASK

Student: __________________ Date: ______ Time: ______ Person recording data: ____________

Record at ten second intervals, for one minute, every ______ minutes. Task/activity __________________________

Observable behavior of student when on-task: __________________________

Recording is for: the whole period ☐ a moment within the period ☐ part of the period ☐

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On-Task Total

Comments:

Directions:
- Determine observable behavior. Examples:
  - Student is looking at the book, on the correct page or turning the page.
  - Student is copying or calculating math problems or using a number line for assistance. Student may be raising his hand waiting for help or talking with the teacher, about math.
  - Student is either getting out a work bin, interacting with materials in a work bin, or putting a work bin away. Talking or humming OK while working.
  - For a one minute recording period, circle on (on-task) or off (off-task) at the end of 10 sec., 20 sec., 30 sec., 40 sec., 50 sec., and 60 sec.
  - Before you begin, determine how often to record. Examples: record every five minutes, for a 30-minute activity (part), or record for an entire 5 minute activity (whole); or record during the 10th minute of a 20 minute activity (momentary).
  - After recording, total the number of intervals the student was on-task for each row, then add the rows to get on-task total.

Adapted from Exceptional Students Education Organization, 2009.
Appendix B: Interview Questions

1. Why are you studying a second language?

2. What are the difficulties/barriers that you face in the second language classroom?

3. How would you rate your reading comprehension in your second language?

4. Describe how you feel when you read a long passage using the traditional methods versus how you feel using technology based materials.

5. In your opinion, what strategies or accommodations can be used in the classroom to make learning a second language accessible for college students with ADHD?

6. What challenges did you face when you enrolled in the second language classroom?

7. What strategies do you usually use to help you improve your second language proficiency, especially reading comprehension?

8. How have you used CAI to learn a second language?

9. Please describe the academic advantages using CAI to learn second language, especially reading?

10. Please describe the academic challenges of using CAI in second language learning, especially in reading?

11. Do you believe that the use of technology helps you gain better academic skills in college? Please explain.

12. Do you believe that you are receiving appropriate accommodations that you need to learn second language? Please explain.

13. What additional information would like to share that I may not have asked you about?