Treatment and Intervention Options for Learners with
Attention Deficit Hyperactivity Disorder

by

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Submitted in partial fulfillment of the requirements for the degree
M.S. Mathematics, Science and Technology Education

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April 2009
Abstract

Many behavioral strategies, such as visual stimulation, have been studied with the purpose of discovering beneficial non-medicated treatment options for individuals who are diagnosed with Attention Deficit Hyperactive Disorder. It has been strongly suggested that children with this Disorder undergo an ongoing diverse treatment plan, one that includes both medication and behavioral interventions. Treating this disorder should take place in both the school setting as well as at home. Physicians, family members, teachers and administrators are encouraged to communicate with one another, review intervention options and create a treatment plan that favorably support children diagnosed with Attention Deficit Hyperactive Disorder. Additional investigations are always recommended in order to continuously discover new ways to improve how students with disabilities are treated.
Dedication

This work is dedicated to a loving and supportive husband, Daniel Swartout. His constant encouragement and support throughout this research was greatly appreciated and played an important role in the completion of this project. All of this could not have been done without Daniel’s unconditional love and limitless patience.
Table of Contents

Literature Review ............................................................................................................... 5

ADHD Overview ................................................................................................................. 5

Basic Treatment Options ............................................................................................... 11

Non-Medicated Interventions ........................................................................................ 13

Implementation Factors ................................................................................................ 20

ADHD Support .................................................................................................................. 22

Summary .......................................................................................................................... 24

Methodology ..................................................................................................................... 25

Purpose ............................................................................................................................... 25

Participants ......................................................................................................................... 26

Development ...................................................................................................................... 27

Procedure .......................................................................................................................... 28

Data Collection .................................................................................................................. 29

Results ................................................................................................................................. 31

Performance Scores ......................................................................................................... 31

Observations ....................................................................................................................... 33

Participant Response ...................................................................................................... 36

Discussion .......................................................................................................................... 39

Conclusion .......................................................................................................................... 43
Treatment and Intervention Options for Learners with

Attention Deficit Hyperactivity Disorder

Since the first diagnoses of Attention Deficit Hyperactivity Disorder (ADHD) many studies have been conducted in order to better understand the disorder and discover effective treatment options for those diagnosed with the disorder. ADHD has been portrayed as a commonly diagnosed disorder among children of all ages beginning as early as preschool. ADHD has been associated with negatively influencing a student’s attentiveness, ability to perform tasks, communicate with others, along with many other behavioral tasks. Common treatment options for symptoms of ADHD have included medications such as Methylphenidate, Adderall, and Ritalin. Some behavioral based interventions have been considered as a form of treatment as well. Many of the commonly used medications are prescribed to manage the interruptive behaviors a child with ADHD may display. Applying medication treatments alone without exploring other non-medicated treatment options has been a common practice. The literature on this topic suggested that medication alone is an insufficient treatment strategy for children with ADHD for many reasons. Non-medicated intervention options have been frequently studied throughout the years. It has been strongly recommended that utilizing both non-medicated interventions alongside prescribed medication will dramatically benefit those who are diagnosed with ADHD and therefore this technique should be considered and pursued.
Literature Review

Researchers have found it imperative that physicians as well as educators, family members and the individual who has been diagnosed with ADHD be well familiarized with the symptoms and affects of the disorder. George DuPaul (2007) and Russell Barkley (2007) are only two of the numerous researchers who have studied ADHD in recent history. Through their efforts, and the effort of many others, breakthroughs have been made regarding the treatment of this disorder. Many have suggested that the best treatment option for children is through the use of both behavioral intervention methods in conjunction with medication. Many intervention options have shown evidence to positively affect academic and behavioral performances from children with ADHD. Reviewing these breakthroughs is a crucial step for those who are frequently exposed to the disorder in order to become more familiar with it. It is essential to understand symptoms of ADHD, and to explore ways to treat these symptoms with the purpose of unraveling valuable and practical ways in which individuals with the disorder are supported and accommodated.

ADHD Overview

Children who appear to have difficulty staying on task, have problems with organization, as well as concentration and those who seem to struggle while interacting with others are demonstrating symptoms of Attention Deficit Hyperactivity Disorder (DuPaul, 2007; Gureasko-Moore, DuPaul, & White, 2007; Mungholm & Fisher, 2008). Mulrine, Prater, and Jenkins (2008) described ADHD as being a, “persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequently displayed and more severe than is typically observed in individuals at a comparable level of development”
Throughout the literature there were several other similar definitions to this disorder. All of which came to an underlying theme that ADHD is a behavioral condition and that can be treated behaviorally as well (DuPaul, 2007; Glass, 2001; Gureasko-Moore, DuPaul, & White, 2007; Mungholm & Fisher, 2008).

The literature repeatedly mentioned that an average of three to seven percent of school aged children are affected by Attention Deficit Hyperactivity Disorder (Brand, Dunn, & Greb, 2002; Gureasko-Moore et al., 2007; Lavoie, 2008; Lee & Zentall, 2002; Shillingford, Lambie, & Walter, 2007; Stormont, 2008; Evans et al., 2006; DuPaul, 2007; Trout, Lienemann, Reid, & Epstein, 2007; Weyandt & DuPaul, 2006). It was explained that symptoms of Attention Deficit Hyperactivity Disorder can appear as early as pre-school (DuPaul, 2007; Weyandt et al., 2006). It was also mentioned that although a child may demonstrate many symptoms of ADHD, he or she may not be classified as having ADHD unless an expert has given an appropriate diagnoses. “An individual could have all of the symptoms and yet not have ADHD” (Lavoie, 2008, p. 75). Therefore in order for a child to be diagnosed, a comprehensive professional assessment is required.

**ADHD history.**

ADHD has been considered to be the leading diagnosed condition among children in the United States (Glass, 2001). Brand, Dunn, and Greb (2002) stated that the number of children who are diagnosed with ADHD has increased significantly over the past decade. In return, this increasing number of children with ADHD over such a short period of time has brought a lot of attention to the disorder and ignited many others to find out more about it. The rising amount of media coverage has, “motivated physicians,
parents and teachers to learn more about how to help children affected by ADHD to learn better at home and in school” (Brand et al., 2002, p. 268).

The first cases of ADHD are thought to have been documented in 1845. Glass (2001) mentioned that initially this disorder was addressed as a medical condition and not considered to be behavioral at all. At first, ADHD as we know it now was classified under names such as restlessness syndrome, minimal brain dysfunction, or hyperkinetic reaction disorder (Glass, 2001). No matter what the time period was, there always was a deep concern for children who were diagnosed with ADHD. This concern was driven by the evidence that children with ADHD were often linked to having problems such as: delinquency, academic underachievement, behavioral problems, school failure, drug abuse, and social and emotional difficulties. It has also been observed that these students tend to have higher rates for failing grades or even dropping out of school (Brand et al., 2002; Glass, 2001). Preventing these academic and social downfalls has motivated others to become more education on the topic.

**ADHD subtypes.**

All children who are diagnosed with ADHD have one thing in common, their disorder. However each child with ADHD is very unique. Each person reacts differently to the disorder and will display different symptoms. However, research has been able to identify and narrow down three distinct subtypes of ADHD symptoms thus far. Throughout the literature it was mentioned that this disorder is a biological condition which is characterized by three major symptoms: inattention, hyperactivity, and impulsivity (Brand et al., 2002; DuPaul, 2007; Gureasko-Moore et al., 2007; Lavoie,
It was observed that a child who is predominately inattentive will have difficulty sustaining concentration, will be easily distracted, but will not necessarily be restless or have impulsive behavior (Lavoie, 2008; Shillingford et al., 2007). This type of student was also observed to often struggle when attending to important and relevant cues. Therefore making it difficult for him to successfully perform in teacher and student led activities (Stormont, 2008). It was also mentioned that this type of student frequently made careless mistakes, and had trouble fully completing tasks. Research has found that being predominately inattentive occurs in about 30 percent of children who are diagnosed with ADHD (Lavoie, 2008).

If a child is predominately hyperactive, it was mentioned that he may have frequent impulsive behavior which may disrupt classroom activities. Impulsivity is a leading concern for a student who is predominately hyperactive (Lavoie, 2008). This type of student struggles to perform activities that require him to sit for prolonged periods of time (Shillingford et al., 2007). A predominately hyperactive child shows signs of having trouble with screening thoughts and actions before acting on them (Stormont, 2008). For example, he may blurt out answers before a question has finished being stated, also he may have difficulty waiting his turn, and often may interrupt or intrude (Shillingford et al., 2007). It was suggested that this type of student may not have any trouble attending to classroom instructions, but would often be restless and act out during
them. The research suggested that this subtype appears in 10-20 percent of children with ADHD (Lavoie, 2008).

The most common occurring subtype of ADHD is a child who is both inattentive and hyperactive. These children have demonstrated signs of inattention, distractibility, hyperactivity and impulsivity combined. This combination can make it extremely difficult for teachers to effectively educate these students through traditional teaching methods. Research found that the combination of inattentive and hyperactive subtype appears in 50-60 percent of children with ADHD (Lavoie, 2008). This type of child currently makes up the majority of children who have ADHD.

*Effects on the child.*

Children with ADHD will find themselves having difficulty performing tasks where their peers will be able to manage effortlessly. Such tasks include coming to class prepared, writing down assignments correctly, performing tasks completely, having sufficient study skills and the ability to complete homework and other assignments successfully and on time (Gureasko-Moore et al., 2007; Lucangeli & Cabrele, 2006; Mulrine et al., 2008). Difficulty with simple classroom tasks may be aggravating for these students. “Regardless of how hard these students try, often other people suggest they are unmotivated or lazy. They may be bright but not be doing well in school or at work. That can be discouraging” (Lavoie, 2008, p. 74). Lavoie (2008) also explained that this frustration can possibly lead to other conditions. It was mentioned that students with ADHD may become depressed, and could often find themselves undergoing frequent cases of anxiety which can lead to sleep disorders such as sleep apnea. This
claim was supported by Brand et al. (2002) who stated that students with ADHD seem capable of learning but struggle with concentration, and performing tasks appropriately due to their hyperactivity, impulsivity and inattention. Lack of support and misunderstanding of this disorder from their peers can cause students with ADHD to develop low self-esteem (Brand et al., 2002). For these reasons, and more, the literature suggested treating symptoms of ADHD at a young age in order to prevent long-term academic failures, and behavioral problems. It was also recommended in the best interest of students with ADHD that their treatments be encourages and ongoing (DuPaul, 2007; Evans et al., 2006; Mungholm et al., 2008; Shillingford et al., 2007; Trout et al., 2007).

**ADHD at school.**

In the literature, students who are diagnosed with ADHD appeared to have significantly lower school motor and processing abilities than students without ADHD and other mild disabilities (Mungholm et al. 2008). Children with ADHD often interrupt classroom activities with their automatic outburst and in return this behavior can distract other students from accomplishing their academic instructions. In subjects such as Mathematics, where the requirements are constantly increasing, addressing students with ADHD is vital (Lucangeli et al., 2006). Constant rises in academic requirements leaves little time for educators to address children with ADHD especially in the middle school years and beyond. Glass (2002) suggested that these draw backs demonstrate a desperate need for an in-depth understanding of this disorder by those involved in the school setting, and that it should be addressed early to avoid interrupting curricular planning and adjustments that may arise later. Similar to the suggestion made by Glass, Dawson (2007) also mentioned that teachers should be well educated about the various
intervention options available, especially those that can be easily implemented into their existing teaching strategy.

*Basic Treatment Options*

A common treatment method found in the literature for ADHD was psychotropic medication (DuPaul, 2007; Gureasko-Moore et al., 2007; Trout et al., 2007). However, “the standard practice of treating ADHD symptoms with psychotropic medication often is not sufficient to promote success in school” (Gureasko-Moore et al., 2007, p. 662). Educators have little control over which student is prescribed medication and at what dose. However, Gureasko-Moore et al. strongly urged parents and teachers to still take the time to become familiar with the possible side-effects a child may have from medication, and to continue to find ways to implement any non-medicated interventions which could possibly in return result in a lower recommended dose of the medication.

*Psychotropic medication.*

Several children with ADHD are prescribed psychotropic medications such as Methylphenidate, Amphetamine, Ritalin, Adderall, Risperdal and more (DuPaul, 2007; Jehlen, 2008; Weyandt et al., 2006). Jehlen (2008) mentioned that an estimated two and a half million children are medicated for ADHD alone. Some children who have ADHD also have other learning disabilities that may require more medication. For the majority of children medicated for symptoms of ADHD, medication has been shown to help them focus more, attend to instruction better, and enhance their productivity and accuracy and even to control their impulses (DuPaul, 2007; Jehlen, 2008).
Even though so many children are being prescribed these medications there are major limitations that do come with them. Trout et al. pointed out that around 20 to 30 percent, nearly one forth of children with ADHD do not physically react well to certain prescription medications. For this reason, many parents are uneasy about allowing their children to be placed on medication (Dawson, 2007; DuPaul, 2007; Jehlen, 2008). This claim was supported by Margaret Dawson who said, “In my clinical practice, I rarely meet a parent who welcomes the idea of medication without reservation, and one of the most frequent questions I get concerns side effects associated with medication” (Dawson, 2007, p. 275). Two situations in an article written by Alain Jehlen (2008) described cases where children had a negative reaction to the medication prescribed to them. It was observed that one child’s symptoms from ADHD had worsened when he began taking his medication, and another child suddenly had trouble breathing after taking medication. Medication alone is an insufficient treatment option, but “critics say that drugs are often a substitute for skilled classroom management in school and conscientious parenting at home” (Jehlen, 2008, p. 34). It is crucial to review and consider other types of interventions for children with ADHD before settling for medication treatments alone.

*Behavioral based interventions.*

There are other ways for children who have ADHD to receive help than just medication itself. Non-medicated interventions can promote positive behavior among children with ADHD. Behaviorally based interventions are beneficial to children with ADHD because they help them work towards, “enhancing attention, addressing hyperactivity, and promoting acceptance” (Nowacek et al. 2007, p. 34). Nowacek et al. suggested that teachers make an attempt to review the available interventions and begin
implementing them into their classroom. Some basic options for teachers that were suggested were to give frequent verbal praise, reinforce desired behavior with tokens, intervene before problematic behavior occurs, provide visual reminders of expectations, and teach students about self-regulation strategies as well as many more strategies (DuPaul, 2007; Mulrine et al., 2008; Nowacek et al., 2007).

**Medication and behavioral interventions combined.**

The literature discovered cases where the combination of medication and behavioral interventions had the greatest effect on a student’s academic performance (Dawson, 2007; DuPaul, 2007; Trout et al., 2007; Weyandt et al., 2006). Also it was noticed that, “when medication is combined with behavior modification, lower doses are effective in achieving the same outcomes as a higher dosage of medication alone” (Dawson, 2007, p. 275). Parents and students are more acceptable of medication when it could be prescribed in a lower dose (Barkley, 2007; Dawson, 2007). At the same time, it is especially important that schools and teachers are also doing their part to apply effective interventions (Barkley, 2007; Evans et al. 2006; Dawson, 2007; DuPaul, 2007).

**Non-Medicated Interventions**

Medication is a very simple, no hassle treatment plan for students who have ADHD. Medication creates an easy solution for parents and teachers alike. However it is important to point out that there have been cases where some students react negatively to medications (Trout et al. 2007). It is also unreasonable to any child who is being treated for any disorder to do the work to treat their symptoms on his own with medication. It is only fair that parents and teachers make an effort to explore non-
medicated interventions in order to provide children with an environment and education that supports them through the process of overcoming their symptoms (Trout et al. 2007).

*Self management.*

The literature described self management as a positive strategy for students with ADHD to learn how to monitor their own behavior (Gureasko-Moore et al., 2007; Trout et al., 2007; Weyandt et al. 2006). Self management interventions require students to regulate their own cognition and behavior when at school and even at home (Trout et al., 2007). Researchers have explained that the technique of self management encourages self responsibility, and in return can minimize the efforts by the teacher to monitor each child’s behavior (Gureasko-Moore et al., 2007). After reviewing self management, Squire (2008) described this technique as a form of self determination. Squire was diagnosed with ADHD as a child, and through his experiences with ADHD he strongly supported self determination for children with ADHD. He stated that, “it is crucial for students to become self determined as early as possible to avoid the experiences I had” (Squire, 2008, p. 126). Self determination can help motivate students and encourage success throughout their education and life.

Gureasko-Moore et al. found that self management may also be implemented through strategies that include self-monitoring, self-evaluation, and self-reinforcement. When self management was introduced to students with ADHD, it was discovered that for most students this strategy, “led to clear, systematic increases in classroom preparation, and behaviors were maintained, for the most part, across all experimental phases” (Gureasko-Moore et al., 2007, p. 654). Following their study, Gureasko-Moore
et al. noticed that students with ADHD who were introduced to the self management strategies were able to perform at an above average of 90 percent, which was similar to the performance of their peers who were without any disability.

The response to self management in the literature has been positive for teachers, parents, and students. At no time in the study conducted by Gureasko-Moore et al. did students suggest that the strategy resulted in problems with their peers. Students with ADHD indicated that this strategy did help them to perform better in school. Teachers have also responded to the self management intervention as being something they would suggest to other teachers, and as an intervention that is appropriate for all students involved (Gureasko-Moore et al., 2007). Parents of students who participated in self management strategies viewed it as being acceptable for their child, and that it caused no adverse effects at home. Not only did they comment on the positive effect it had on their child’s academics, but they also noticed that self management strategies benefited their child’s behavior while at home as well. If schools begin to consistently implement self management strategies at the elementary level, it was suggested that students may continue to practice the strategy and benefit from it well into middle school and beyond (Gureasko-Moore et al., 2007).

_School based management._

Some interventions that take place in the school environment include antecedent-based interventions, and consequence-based interventions. Antecedent-based interventions, which were also referred to as a proactive treatment, are implemented by teachers by manipulating the surroundings prior to the performance and measurement of
an academic task, as well as any problematic behaviors (DuPaul, 2007; Trout et al., 2007; Weyandt et al., 2006). An example of an antecedent-based intervention would include the strategy of frequently displaying and referring to classroom rules (Dawson, 2007). This strategy helps to frequently remind students what their expectations are and that the rules and expectations are continuously encouraged while keeping the students aware and engaged in classroom activities. Steele (2007) added to this idea by suggesting using real-life examples in classroom activities because they may engage students more in what they are learning. Steele also recommended reminding students to check their work as they go. Trout et al. (2007) conducted a study that revealed antecedent-based interventions also included beneficial strategies such as reducing the level of noise in the classroom during activities, giving students choices, and addressing instruction in a direct manner. Bennett, Zentall, and French (2006) suggested, “Enriching the curriculum with options, even minimal changes, could differentially improve the behavior responses of students with ADHD” (Bennet et al., 2006, p. 201).

Trout et al. (2007) mentioned that in order to implement consequence-based intervention teachers will need to manipulate the child or environment only when responding to a target behavior that the child has demonstrated. In support of this claim, Weyandt et al. (2006) described consequence-based interventions as a type of reactive treatment. The literature suggested that strategies for consequence-based interventions include token reinforcement, rewards for positive behavior and for good academic achievement, time-out procedures, and other response cost strategies (Dawson, 2007; Trout et al., 2007; Weyandt et al., 2006). In the literature all of these strategies showed to have a positive effect for children with ADHD (Trout et al., 2007).
Peer tutoring.

Peers of students with ADHD play an important role in addressing problems associated with ADHD. Trout et al. (2007) explained that peers can assist students who have ADHD and can help the teacher implement certain intervention strategies. On strategy that was suggested calls for classmates being paired with students who have ADHD during classroom assignments and projects. One-on-one assistance was shown to be beneficial for students with ADHD for many reasons. Trout et al. suggested that peer tutoring could help engage those with ADHD because their peers would be able to guide them through tasks and keep them focused. It was also suggested in the literature that working with peers, students with ADHD received immediate feedback, and continuous prompting and praise on their behavior and achievement which is always rewarding for those with ADHD (Nowacek et al., 2007; Trout et al., 2007; Weyandt et al., 2006). By utilizing peer-tutoring techniques, these students can help the teacher reinforce other strategies such as antecedent and consequence interventions (Trout et al. 2007).

Family based management.

Family based interventions are similar to the strategies mentioned in peer-tutoring. Parents should be encouraged to help assist their children at home with their homework assignments, also closely monitor the completion of each task, and praise children when they are demonstrating good behavior. It was explained that parents and other family members have a great opportunity to reinforce consequence-based interventions and they should take advantage of it (Trout et al., 2007). Parents and family members at home can help carry on the tasks of the teacher at home by applying similar
reinforcements that are used in school (Shillingford et al., 2007). In order for families to be effective with this type of intervention, it was suggested that they participate in parent training, family therapy, behavioral family system treatment, as well as frequent family check-ups to obtain a better understanding of the strategies that help children with ADHD and how to apply them appropriately (Evans et al., 2006).

Movement strategies.

Many students with ADHD have a difficult time sitting in one position for a prolonged period of time. The literature mentioned that these students can easily lose their motivation and rapidly become distracted. It was suggested that activities that include movement may assist students with better concentration, and may in return help them control their impulsivity longer (Mulrine et al., 2008). It was commonly stated that exercise is necessary not only all children, but specifically for children with ADHD. Mulrine et al. mentioned that exercise and movement during a school day and class period promoted academic success, positive self-image, enhanced memory, and reduced the number of disruptive behavior and social problems from students with ADHD. In the literature, some teachers at the middle school level found it difficult to incorporate these and other types of interventions due to the school structure. However, they did mention that the typical structure of a secondary school schedule, where students move around in-between classes, may benefit those with ADHD. This idea was supported by Nawacek et al. who quoted teachers explaining that switching classes every period may provide the necessary movement for students with ADHD to keep them from becoming distracted and unfocused throughout the day.
Some tips for educators were revealed in the literature for applying movement strategies. The tips included moving around the classroom during instruction, and providing many opportunities for students to move around the room themselves by giving them various jobs such as handing out papers, and writing examples on the board (Mulrine et al., 2008). Mulrine et al. also suggested that incorporating games into the curriculum may also benefit students with ADHD. Games not only engage students, but they may also teach students important listening and responding skills. Mulrine et al. pointed out that games could help students to practice and learn skills such as respecting personal space, reading social signals, coping with teasing, and managing their anger all of which are skills students with ADHD lack. Incorporating some form of movement and exercise in daily routines and within instruction has great potential to increase motivation for students with ADHD as well as allowing them to become fully engaged and remain on task (Mulrine et al., 2008).

*Visual stimulation.*

Lee and Zentall (2002) conducted a study that measured the effects visual stimulation had on children with ADHD through the use of computers. There are many other ways to incorporate visual stimulation in a learning environment. Throughout the literature some examples of visual stimulation included the use of colors, images, symbols and movement. It was mentioned that visual stimulation can be included on the walls throughout the school building, anywhere in classrooms, as well as on classroom materials. In result of the study conducted by Lee et al., it was concluded that in cases where visual stimulation was utilized participants with ADHD completed more tasks, and could complete more tasks correctly than without the use of visual stimulation. Visual
stimulation also appeared to reduce any unrelated activity and movement. Results from the literature, based on visual stimulation supported the optimal stimulation theory which states, “Individuals engage in activity to maintain an optimal level of stimulation and individuals with ADHD require more stimulation than typical individuals” (Lee et al., 2002, p. 280). Visual stimulation has been suggested to maintain students’ motivation and attention throughout various tasks.

Implementation Factors

Glass (2001) and Nowacek et al. (2007) both noticed that there are certain teachers who are more likely to utilize the suggested interventions for students with ADHD than others. A teacher’s tolerance level for the behavioral traits of ADHD may determine a teacher’s motivation to take the time to implement interventions in the classroom and it may also impact the manner in which these interventions are applied (Glass, 2001). Also a teacher’s acceptance of certain interventions, along with team made decisions, and availability of resources were shown to impact a teacher’s decision when accepting certain interventions from others (Nowacek et al. 2007).

Glass (2001) distributed a number of surveys to five private schools in South-eastern Virginia in order to learn more about the factors influencing the use of teaching strategies for students with ADHD. Glass found that the years of experience a teacher has was not as significant as the age of the teacher when referring to the use of these strategies. It was noticed that older teachers were more likely to utilize teaching strategies than teachers who were younger. Glass suggested that older teachers may be more flexible by nature due to life experiences in general than solely based on their years of teaching experience. Years of experience did have a similar response though. It was
also mentioned that teacher with more than twenty years of experience were more likely to use suggested teaching strategies in their classroom than teachers with less experience (Glass, 2001).

Another factor that can influence a teacher’s probability to utilize positive teaching strategies may be based on the amount of knowledge there is about ADHD. Among the teachers who completed Glass’ survey, seventeen percent of them reported not being given any information about ADHD from their school administrators. It was suggested that lack of knowledge may create hesitation when deciding to use a teaching strategy. Along with lack of knowledge, lack of resources and lack of time may also be a factor for a teacher’s consideration to implement new strategies into the curriculum whether or not there is evidence to show that children with ADHD benefit from the strategies (Glass, 2001).

In the literature it was discovered that teachers seemed to prefer interventions that required minimal preparation (Nowacek et al., 2007). A way to maximize time, it was suggested that teachers engage in a collaborative process where teachers consult with each other, school counselors, and parents in order to identify appropriate interventions that they may be willing to implement in their classroom (Dawson, 2007). “It becomes more challenging to design and implement interventions, because the cooperation and sustained effort of many teachers rather just one is required” (Dawson, 2007, p. 276). Glass (2001) suggested that overall teachers of all ages need to strive to be willing to become flexible with these suggested strategies, their curriculum and find ways to utilize any information that is given to them.
ADHD Support

People who are diagnosed with ADHD will need constant support from their peers. Living with a disorder is complicated enough for any individual with or without the support of others. Overcoming the struggles that arise when someone is dealing with ADHD has been suggested to become less frustrating when he is supported by the people around him (Dawson, 2007; Glass, 2001; Stormont, 2008). One step to become supportive can be from having a better understanding about ADHD and learn what people who are diagnosed with the disorder go through on a daily basis. It is important for schools, family members, as well as the individual who has ADHD become more knowledgeable about the disorder.

Academic support.

It has been suggested that schools should consider increasing the number of classroom assistance or to aim for smaller class sizes to allow more room and time for teachers to devote to the needs of diverse learners (Glass, 2001; Stormont, 2008). Specialists and administrators were asked to advocate the knowledge of ADHD and intervention options that are available to teachers. It was stated that professional development opportunities and teacher preparation programs are necessary to help teachers to better address behaviors that interfere with academics (Nowacek et al. 2007). Similarly, Glass (2001) made it clear by stating:

The responsibility of the school administrators is threefold: to ensure that relevant information reaches all teachers, to provide the younger, less experience teachers with mentors to help them learn to utilize positive teaching strategies and to staff
the schools adequately to ensure that the teachers have enough time to address the needs of every child. (p.78)

*Parental support.*

Both parents and physicians are reluctant to place children on medication for any reason. The support of parents is necessary to help research and explore alternates to medication and understand the various other strategies that may help reduce the excessive need or dosage of medication (Dawson, 2007). In order to strengthen and continue parental understanding and support of non-medicated interventions, Dawson suggested implementing parental consultations where parents can learn more about ADHD. Parents should be educated on alternatives to medication, they should understand the behavior the results from ADHD, and should review the effective discipline strategies, social-emotional development plans, and other characteristics of ADHD and interventions so they can make sure to reinforce them when their child is at home (Dawson, 2007).

*Individual support.*

Children with ADHD need to be willing to learn more about their disorder, and undergo the treatment plan that has been selected for them. “In my clinical practice, children with ADHD at the middle school level are more likely to resist both medication and any other kind of intervention designed to reduce the symptoms associated with their attention disorder” (Dawson, 2007, p. 276). Involving students in the decision-making process when deciding which interventions are to be implement may increase their motivation to comply with the techniques because they then have a sense of ownership on the decision (Dawson, 2007; Weyandt et al., 2006).
Summary

The number of children who are diagnosed with ADHD is increasing. As the numbers increase, so should the amount of effort physicians, parents and educators put in to better understand and better treat the disorder. Research has provided many suggestions of treatment strategies and they have provided evidence for each of their suggestions. Nevertheless, it is necessary to point out that, “the performance of an individual student can never be predicted with 100 percent accuracy based on the performance of a group as a whole” (Mungholm et al., 2008, p. 130). However, through careful observations of individuals we can come to understand what to expect from students with ADHD. Every study throughout the literature called for further examinations of ADHD symptoms and treatment options. Additional research on any topic is always necessary in order to continually strive for better understandings and new developments. The information currently provided through the completion of existing research studies should still encourage others to begin an exploration of ADHD and to discover new ways that will benefit those who are diagnosed with the disorder.
Methodology

The object of this study was to review the potential benefits visual stimulation may have on learners with ADHD. This study was influenced by a similar study conducted by David Lee and Sydney Zentall titled, *The effects of Visual Stimulation on the Mathematics Performance of Children with Attention Deficit/Hyperactivity Disorder*. In their study they tested the effect of visual stimulation by projecting mathematical problems on a computer screen and compared the progress to problems that were displayed in a traditional manner on paper. In the current study visual stimulation was tested through the use of four similar worksheets that varied based on the color of the paper and the format of the problems. The goal of this study was to observe whether the use of visual stimulation through the use of color and different formats would result in an increase in academic behavior by students with ADHD.

Purpose

Zentall suggested that, “individuals with ADHD require more stimulation and novelty than so called ‘normal’ individuals to achieve and maintain an optimal level of arousal in a given context” (Lee et al., 2002, p. 272). It was also mentioned in previous studies that assessed the effect of visual stimulation on students with ADHD that the use of color in the classroom environment resulted in decreased amounts of unrelated activity and would enhance the performance and persistence of their behavior. Based on these ideas the researcher for this study chose visual stimulation as an important topic to study further. This study was supported by various similar reports that visual stimulation may benefit students with ADHD and because visual stimulation requires minimal effort by teachers in order to incorporate it into their daily instruction. The specific method of
visual stimulation used in this study was chosen in part because it would require taking away little time from a classroom teacher and also to minimize the amount of interruption of the ongoing curriculum.

Participants

This study was implemented in a middle school in upstate New York. A seventh grade Math teacher was asked if any of her classes could participate in this study. Permission was also granted by the school principle. The cooperating teacher taught five class periods in a school day. Only two of her classes were used for this study. Each class varied in size, and included different amounts of students with learning disabilities. It was expected based on her typical class sizes that fifty-five students would participate in this study. In total, eleven students within those two classes were diagnosed with a learning disability. If any student was absent for at least one worksheet his scores from other worksheets would not be included in the overall results because it would be unclear how that student would have done on the worksheet that was missed. Without evidence from each worksheet a fair calculation and analysis would be unattainable.

It was explained to the teacher and the school principle that no names would be used in the study in order to maintain confidentiality of those involved. However, it would be necessary for the researcher to be informed which students in the study were diagnosed with ADHD and any other learning disabilities in order to effectively analyze the results. The researcher used this information only to collect the data from. Once the data was collected and the study was complete the information, including the participants’ names and disabilities, were disposed of.
Permission was requested and granted from the principle of the school after a carefully developed and detailed description of the study was presented to him. Due to the minimal changes in environment and behavior in the classroom it was not necessary to obtain permission from the parents of the participants, or the participants themselves. The participants were told that the researcher was conducting research and it would require them to perform four timed multiplication worksheets. It was never specified whether or not the results from the worksheets in this study would affect their grade for their class. The students were given no further information about the specific reasoning for the study in order to encourage honest and fair results and prevent deliberate miscalculations.

Development

The researcher met with the teacher prior to the study to discuss the quality of the material being used in the study and also to sort out the class list to determine who and how many students in each class were diagnosed with ADHD and any other learning disabilities. The researcher kept this information in a safe location and allowed no one else to view it. She also would not discuss the results of the study with anyone until the study was complete and the names of students were disposed of. During the conference with the classroom teacher a schedule was made determining which days and what times the study would take place for each class.

During this study, four worksheets were designed. Each of the worksheets contained fifty double digit multiplication problems that were appropriate for students at the seventh grade level. As suggested in the study by Lee et al. (2002) the numbers one and zero were not included in any of the mathematical problems in order to control the
difficulty of each problem. Also, there were no problems with duplicated numbers in the problem, and out of all four worksheets there were no duplicated problems, each worksheet had different problems. The first worksheet was printed on traditional white paper with all fifty problems on one page in five columns of ten problems (Appendix A). The second worksheet was also printed on white paper with only ten problems per page with two columns of five problems (Appendix B). The third worksheet had the same format as the first worksheet with all of the fifty problems on one page, but it was printed on blue paper (Appendix C). The fourth worksheet had the same format as the second worksheet where only ten problems were posted per page but this time the problems were printed on blue paper (Appendix D).

Procedure

The researcher met with each class four times during the duration of the study. In the study conducted by Lee et al. only students with ADHD were used for the study and they were pulled from their normal environment in order to participate in the study. In contrast to the study by Lee et al., the researcher of this study met with the entire class in their current classroom. All of the students who were present in class that day, both those who were diagnosed with ADHD and those who were not, participated in the study. The participants were never asked to leave their normal environment to participate in this study and no one was singled out due to their disability or lack thereof. The classroom was set up in the same formation with which the teacher prepared her class for each day. The desks were in rows spaced apart from one another with each desk facing the chalk board. The participants were also required to work at the desk that the classroom teacher had assigned to them during the school year.
The researcher met with each class on different days throughout the course of 3 weeks. On each occasion the participants were engaged in the same routine. Before the sheets were handed out they were told that they would be given a worksheet with fifty multiplication problems. They were also told that their task was to complete as many problems correctly as they could in the time allowed, which was five minutes. The worksheets were handed out face down to each student. Once everyone had a worksheet they were told to write their names on the back of the sheet. When the researcher noticed that everyone was ready they were given the signal to turn the sheets over and begin. The researcher sat in the front of the classroom while the students worked on the problems. As the students were working on the problems the researcher observed the behavior of the students in the room while also monitoring the time. When the five minutes were up, the students were told to put their pencils down, turn the worksheets over and pass them forward. The researcher then collected each worksheet, and left the classroom. Before collecting the final worksheet, but after the class had completed the worksheet, the researcher asked the students to comment on which of the four worksheets they preferred and to give a reason. They were asked to write their opinions on the back of the fourth worksheet. Once the students were finished making their comments, the worksheets were collected and the researcher left the classroom for the final time.

Data Collection

Data from each worksheet was collected, recorded and analyzed. For each worksheet three specific data points were closely observed: the number of problems attempted, number of problems answered correctly, and the number of problems answered incorrectly. Three additional data points were calculated based on their
results: the percent of the problems answered correctly out of the total amount of problems, which was fifty, then out of the number of problems they attempted and an overall average was taken from these two percentages. The data was recorded in a table listing all of the data points together (Appendix E). Participant responses were then tallied and recorded in a separate table (Appendix F), and lastly, a detailed comparison of the results was performed.
Results

This study revealed intriguing statistics that were drawn from three categories: performance scores, observations and participant comments. Each category contributed to the analysis of the overall data and the conclusions that were made in result of this study. Tables were used to organize the data in a way that would easily display participants’ scores from the worksheets, also showing their averages and their comments. The researcher made many observations to the participants’ behavior and their discussions before, during and after each worksheet which helped to explain certain outcomes performed by the students. The final data point was gathered by the responses that the participants made at the completion of the last worksheet. By combining all of these facts an enlightening discussion was developed about the relationship between ADHD, visual stimulation, and student performance.

Performance Scores

The total number of participants for this study came to forty-five students. Eleven of those students were absent for at least one of the worksheets during the course of the study which meant that their scores on any of the other worksheets were not included in the results for this study. Only the data from those who were present for all four worksheets were measured in the analysis for this study. Out of the forty-five participants, eleven of them had ADHD. Three of them were among those who were absent at some point during the study so the scores they received on other worksheets were void. Therefore, scores from eight students with ADHD were utilized in this study.

After calculating the number of problems each student completed correctly and by comparing that number to the total number of problems, and to the number of problems
attempted, an overall average was calculated to represent how each student performed on each worksheet. The majority of participants performed the best on the final worksheet. There were thirteen students who received their best score on this worksheet, and of those thirteen none of them were students with ADHD. Ten participants received the best average on the third worksheet. Of those ten, three of them were students with ADHD. Nine participants performed better on the first worksheet. Of those nine four were students with ADHD. Lastly, six participants performed their best on the second worksheet, and of those six students, two were students with ADHD. Considering only students with ADHD, the majority of them performed the best on the first worksheet.

The first worksheet included none of the additional visual stimulation methods that were used in this study. The next worksheet that students with ADHD performed best on was the third worksheet. The third worksheet was the same format as the first worksheet but it utilized one method of stimulation which was the color of the paper. This was followed by the second worksheet which included only the format change. Meanwhile, none of the students with ADHD performed best on the final worksheet which incorporated both methods of visual stimulation, the use of color and adjusted format.

When these performance scores were shared with the classroom teacher she observed many surprising results. In the second class, there was one girl who was performed better than the rest of her classmates consistently throughout all four worksheets. Also, on the fourth worksheet she was the only participant who was able to answer all fifty problems correctly in the five minutes. The classroom teacher commented on her performance during other classroom activities stating that she often struggles in math and falls behind due to this. It was surprising to the teacher that she was able perform as well
as she did on each of the worksheets. The teacher also noticed that one of her strongest students in her Math class did not do as well as expected on the worksheets.

Observations

At the beginning of the first round of worksheets the researcher noticed that each class seemed excited for the task presented to them. As the students were working on the first worksheet it was observed that many students were using various techniques to complete as many problems as they could. Some students were using the lattice strategy for multiplication which they had learned when they were first introduced to the concept of multiplication. Other students were multiplying in a traditional manner and some of them were not answering the problems in order, rather they were skipping around the page. It was clear that all of the students were completing problems at a different pace despite the method they were using to solve the problems. After the first worksheet was complete the researcher was able to score them and take a closer look at the students’ work. It was then noticed that the students who were skipping around the page were filtering through the problems and answering simpler problems first, which commonly consisted of problems that included lower digits such as twos and threes.

When the second worksheet was given to the students, a few did not seem as enthusiastic to participate, but the majority of them were still excited to participate and attempt to perform better than they had on the first worksheet. The students who utilized the lattice strategy on the first worksheet continued to use it on the second worksheet. It was noted that on the second worksheet these students now had more room to write their work for the lattice strategy. With that in mind, even though it was necessary for them to flip through pages during this worksheet, these students were able to complete a few
more problems than on the first worksheet. It was also observed that more students engaged in the technique of indentifying and calculating simpler problems first. However, it did not appear that these students were able to complete many more problems than on the first worksheet when using this technique.

The second worksheet required participants to flip through the pages in order to continue on to the next problem. It was evident that everyone could hear the papers being turned as students were moving on to the next page. Some students would look up and turn their heads when someone else would turn a page. The page turning from the second and fourth worksheet did produce more noise throughout the classroom during the study. Overall, based on the results, fewer students were able to perform better on the second worksheet, however almost double that number did perform better on the fourth worksheet which was presented in the same format as the second worksheet but this time it was printed on colored paper.

At the completion of the second worksheet, many of the students in the first class began to share with one another how many problems they were able to complete. They were astonished and amazed by how many more or how many less problems someone else could complete. The researcher noticed that many students in this class began to ask those who completed a larger number how they were able to do so. This is where it was realized that the students in the first class were beginning to share each other’s strategies with one another. They were assisting their classmates to give them ways in which they could perform better next time. The second class however, which contained the majority of students with ADHD, did not ask each other how many problems everyone completed or even talked about what strategies each other were using in order to possibly improve
their work for next time. Some of them did turn to a classmate and ask how many problems they were able to finish, but the discussions about the worksheet stopped there. The students in the second class did not appear to plan ahead for the next worksheet.

When the third worksheet was given to the first class the students were very curious to learn how they did on the second sheet, and to find out who was able to answer the most problems correctly so far. When the third worksheet was given to the second class, many students seemed discouraged to complete another worksheet, but they were interested to learn who was able to finish the most problems on the second worksheet. One student in the first class announced that he felt he would do much better on the third worksheet because another student in the class had taught him a more rapid way to complete double digit multiplication problems. In fact, when the researcher scored his answers, this student was able to significantly complete more problems in the five minutes provided.

Overall, as stated previously, ten students were able to perform their best on the third worksheet, three of them being students with ADHD. The lattice strategy was still the strategy of choice for some students, while others continued to use traditional methods, and others would still filter through the problems to work on simpler problems first. Students who were calculating through the lattice method were not able to complete more than fourteen problems on any given worksheet. Many students, even if the third worksheet was not their best worksheet did see an improvement with their scores on this worksheet. Both the first worksheet and the third worksheet were formatted the same way with all fifty problems on one page, while the third worksheet was printed on colored paper. The colored paper in this case did not produce an overwhelming dramatic
increase in academic progress when compared to the results of the first non-colored worksheet, but many students did perform slightly better. Their accuracy of the problems attempted was greater than on the first worksheet. The third worksheet contained one more student who performed better than the number of those on the first worksheet, but had one less student with ADHD who performed better.

The classroom behaviors for both classes during the fourth worksheet were similar to that of the previous worksheet, except it seemed that more students in the second class were losing motivation by this point in the study. One student, who was scoring among the top two or three students during the first three worksheets in the study, appeared discouraged when he found out that he was repeatedly not performing better than certain students in the classroom. His behavior during the fourth worksheet was dramatically different than when the first worksheet was administered. During the first worksheet this student clearly was rushing through each problem. During the final worksheet this same student was no longer rushing, and was taking his time completing problems. He received his lowest score on the final worksheet.

**Participant Response**

At the end of the final worksheet each student was asked to explain which worksheet they preferred. When the researcher reviewed their responses, the data did not reveal any overwhelming scores. The responses were almost evenly scattered among the four worksheets. The first worksheet had the most votes. Sixteen students preferred the first worksheet, while only nine actually gave their best performance on the first worksheet. Similar to the number of votes for the first worksheet, fifteen students preferred the last worksheet. Thirteen students actually performed their best on the final
The next preferred worksheet was the third worksheet with eleven votes, where ten students overall performed the best on the third worksheet. Lastly, the second worksheet was preferred by ten students, but only six received their best scores there.

Some students voted on more than one worksheet. Most students who voted on more than one worksheet tended to vote on the two worksheets that contained the same format. Some of them even mentioned that they preferred the format that was used in the worksheets mentioning that the color of the paper did not play a role in their performance or preference. Overall, many of their explanations for each worksheet were similar to one another. In most cases they described the method of visual stimulation as their reasoning for preferring one worksheet over another. For examples, the students who chose the first worksheet mainly chose it because all of the problems were on one page. One student explained that he preferred the white paper over the colored paper, while another student mentioned that he preferred the colored paper better than the white. The majority of students who chose the second worksheet chose it because gave them more room to write their work. Most students who chose the second worksheet also voted on the fourth worksheet for the same reason. The leading reason that students chose the third worksheet appeared to be very common to the first worksheet. Overall, only a few students mentioned the color of the paper in their reason for choosing a specific worksheet.

The worksheet that most students said they preferred was not the actual worksheet that they performed the best on. For example, the student who was mentioned during the fourth worksheet for losing motivation towards the end had chosen the first worksheet as his preferred worksheet. He did not mention the format or color of the paper in his
reason. His reason for selecting the first worksheet was because he thought he had received the best score on the first worksheet, when in fact his actual best score was on the second worksheet. Very few students had chosen the actual worksheet that they performed the best on as their preferred worksheet.
Discussion

The purpose of this study was to explore the possible effects that visual stimulation had among students with ADHD when compared to those without the disorder. The objective was to determine if there existed a positive relationship between visual stimulation and academic behavior and performance. The data obtained from each of the worksheets was carefully analyzed to reveal any correlation between the two types of visual stimulation used in the study and how it may have affected a student’s performance. Even though visual stimulation was the object of this study, it seemed as though the data could have been influenced by more than only the effects that the visual stimulation had. All possible factors that may have affected the students’ performance were carefully considered in the overall conclusions that were drawn from this study.

As stated previously, the majority of students had performed their best on the final worksheet. However, none of them were students with ADHD. This may be explained when it was observed that many of the students who had no learning disability were engaging with one another throughout the study in order to find ways that they could improve their scores. Many students may have also been performing better on the third and fourth worksheets because of the practice they were receiving from the previous worksheets. One student even put the practice he had received from previous worksheets as his reason for selecting the fourth worksheet as the one he preferred the most. When a closer look was taken to the averages by both students with ADHD and those without, it was clear that students without ADHD were able to continuously attempt more problems than the students with ADHD. However, the accuracy of the problems they attempted seemed to be very similar among all of the students. Zentall et al. (2006) mentioned in
their study that students with ADHD often perform less accurately than their peers. Based on the scores in this study that claim was not the case here. It was evident that students with ADHD in this study could not complete as many problems as their peers, but there existed no drastic difference in their accuracy of the scores from the problems they had attempted.

Another factor that may have affected the results was their dependency on non-traditional methods of multiplication and their dependency on calculators. There were a few students who still relied on the lattice method of multiplication which requires more time to layout the lattice for the multiplication. The students who used the lattice method to perform their multiplications overwhelmingly completed less problems than the rest of the participants. The student that the classroom teacher noticed did not perform as well on the worksheets even though he is one of her strongest students in Math could be explained by his dependency on the calculator. This student was not one of the students who had ADHD, and it was explained that he often excels in math class, but also relies on the calculator for his calculations. This study required him to compute problems on his own which caused him to perform at a slower pace than his peers who are not calculator dependant.

The results gathered from each worksheet may also be explained by various factors, not just by the effects that visual stimulation may have had. Although none of the students with ADHD performed better on the final worksheet, it was noted that this was not the worksheet where most of these students performed the worst on. The final worksheet fell somewhere in the middle in regards to their progress. In most cases, the results the students received on the second worksheet were very similar to the final
worksheet. Both worksheets had the same format, but the final worksheet was printed on colored paper. It seemed at first that in the case where both conditions of visual stimulation were utilized, color and adjusted format, it had little positive effect on the performance of students with ADHD, but it also did not hinder their scores any. Therefore, based on this study it could be stated that participants with ADHD did not seem to gain any advantage from the final worksheet where two methods of visual stimulation were utilized, but they also did not reveal any disadvantage either.

Zentall et al. (2006) explained that, “students with ADHD appear to have difficulty maintaining attention to repetition” (Zentall et al., 2006, p. 189). The fact that the students in the second class, which consisted mainly of students with ADHD, appeared to lose motivation towards the final worksheet could have been explained by the repetition of the study and not solely based on where visual stimulation was used. The students knew that each worksheet would contain fifty problems and they would have five minutes to complete as many problems as they could. The task at hand for each worksheet never changed. Based on the statement made by Zentall et al., an accurate conclusion based on student performance in regards to the use of visual stimulation cannot be made here. The potential beneficial effects that visual stimulation may have had on students with ADHD could have been overshadowed by the students’ lack of motivation due to the repetition of the study. Both classes received each worksheet in the same order which made it impossible to see the progress some students could have made if the third and fourth worksheet were given first.

Overall, the data gathered from this study seemed to be inconclusive. The performance scores appeared to be influenced by more than the effects of visual
stimulation alone which does not allow for a definitive answer to the objective of this study. Also, the participant responses were closely evenly distributed among the four types of worksheets which did not reveal any overwhelming preferred style of visual stimulation. However, because their preferences were evenly distributed, this does support the claim that every student has their own preferred learning style and that there should always exist a diverse learning environment for all students.
Conclusion

The scale of this study may not have been large enough to reveal any strong relationships between visual stimulation and the academic behavior among students with ADHD. Factors other than the use of visual stimulation also contributed to the outcomes of this study. Suggestions for future research would be to increase the number of participants, specifically to include more students who are diagnosed with ADHD. If multiple worksheets are to be used in a future study across multiple groups of students it is strongly recommended that the order in which the worksheets are administered be varied between groups. This will help the researcher to identify a student’s performance on each worksheet despite the influence that may come from the order that it is presented. Varying the order will also allow more insight to the effects that visual stimulation has without the results being based heavily on the order that it was distributed. Although the results of this study did not overwhelmingly reveal any dramatic results to strongly suggest a correlation between visual stimulation and student performance, the literature has previously provided evidence to suggest that it may in fact benefit students especially those who are diagnosed with ADHD. In any case, further investigations are always necessary in order to build a deeper understanding of ADHD and to discover new ways in which these individuals may be treated. The literature overwhelmingly suggested that a diverse treatment plan that includes both medication and non-medicated interventions, and through the understanding and support from others, students with ADHD will have the best chances of succeeding.
References


Appendix A
Worksheet One

Name: _____________________________  Date: ____________

Directions: Complete as many problems as you can.

1. \[\begin{array}{c}
69 \\
\times 8
\end{array}\]  
11. \[\begin{array}{c}
74 \\
\times 2
\end{array}\]  
21. \[\begin{array}{c}
32 \\
\times 9
\end{array}\]  
31. \[\begin{array}{c}
84 \\
\times 9
\end{array}\]  
41. \[\begin{array}{c}
46 \\
\times 9
\end{array}\]

2. \[\begin{array}{c}
35 \\
\times 7
\end{array}\]  
12. \[\begin{array}{c}
48 \\
\times 5
\end{array}\]  
22. \[\begin{array}{c}
63 \\
\times 4
\end{array}\]  
32. \[\begin{array}{c}
73 \\
\times 5
\end{array}\]  
42. \[\begin{array}{c}
84 \\
\times 5
\end{array}\]

3. \[\begin{array}{c}
42 \\
\times 9
\end{array}\]  
13. \[\begin{array}{c}
57 \\
\times 2
\end{array}\]  
23. \[\begin{array}{c}
62 \\
\times 7
\end{array}\]  
33. \[\begin{array}{c}
54 \\
\times 6
\end{array}\]  
43. \[\begin{array}{c}
32 \\
\times 5
\end{array}\]

4. \[\begin{array}{c}
74 \\
\times 8
\end{array}\]  
14. \[\begin{array}{c}
29 \\
\times 4
\end{array}\]  
24. \[\begin{array}{c}
68 \\
\times 4
\end{array}\]  
34. \[\begin{array}{c}
56 \\
\times 7
\end{array}\]  
44. \[\begin{array}{c}
67 \\
\times 9
\end{array}\]

5. \[\begin{array}{c}
97 \\
\times 6
\end{array}\]  
15. \[\begin{array}{c}
75 \\
\times 2
\end{array}\]  
25. \[\begin{array}{c}
97 \\
\times 4
\end{array}\]  
35. \[\begin{array}{c}
39 \\
\times 8
\end{array}\]  
45. \[\begin{array}{c}
87 \\
\times 3
\end{array}\]

6. \[\begin{array}{c}
43 \\
\times 9
\end{array}\]  
16. \[\begin{array}{c}
37 \\
\times 4
\end{array}\]  
26. \[\begin{array}{c}
36 \\
\times 9
\end{array}\]  
36. \[\begin{array}{c}
32 \\
\times 7
\end{array}\]  
46. \[\begin{array}{c}
42 \\
\times 3
\end{array}\]

7. \[\begin{array}{c}
69 \\
\times 7
\end{array}\]  
17. \[\begin{array}{c}
26 \\
\times 8
\end{array}\]  
27. \[\begin{array}{c}
48 \\
\times 9
\end{array}\]  
37. \[\begin{array}{c}
95 \\
\times 4
\end{array}\]  
47. \[\begin{array}{c}
25 \\
\times 6
\end{array}\]

8. \[\begin{array}{c}
94 \\
\times 3
\end{array}\]  
18. \[\begin{array}{c}
89 \\
\times 7
\end{array}\]  
28. \[\begin{array}{c}
73 \\
\times 2
\end{array}\]  
38. \[\begin{array}{c}
37 \\
\times 6
\end{array}\]  
48. \[\begin{array}{c}
97 \\
\times 2
\end{array}\]

9. \[\begin{array}{c}
24 \\
\times 3
\end{array}\]  
19. \[\begin{array}{c}
64 \\
\times 2
\end{array}\]  
29. \[\begin{array}{c}
72 \\
\times 8
\end{array}\]  
39. \[\begin{array}{c}
45 \\
\times 6
\end{array}\]  
49. \[\begin{array}{c}
68 \\
\times 3
\end{array}\]

10. \[\begin{array}{c}
98 \\
\times 3
\end{array}\]  
20. \[\begin{array}{c}
43 \\
\times 6
\end{array}\]  
30. \[\begin{array}{c}
65 \\
\times 7
\end{array}\]  
40. \[\begin{array}{c}
24 \\
\times 9
\end{array}\]  
50. \[\begin{array}{c}
57 \\
\times 8
\end{array}\]
Appendix B
Worksheet Two

Name: _______________________    Date: ___________________

Directions: Complete as many problems as you can.

1. $78 \times 4$

2. $94 \times 8$

3. $92 \times 3$

4. $75 \times 9$

5. $68 \times 9$

6. $59 \times 4$

7. $83 \times 7$

8. $47 \times 3$

9. $93 \times 7$

10. $34 \times 8$
11. 76 x 3
16. 68 x 2

12. 35 x 6
17. 42 x 5

13. 47 x 6
18. 57 x 4

14. 57 x 9
19. 72 x 6

15. 82 x 5
20. 52 x 6
21. \[43 \times 2\]
26. \[78 \times 5\]

22. \[59 \times 3\]
27. \[73 \times 6\]

23. \[39 \times 7\]
28. \[85 \times 3\]

24. \[95 \times 7\]
29. \[47 \times 9\]

25. \[26 \times 7\]
30. \[75 \times 6\]
31. \[25 \times 7\] 
36. \[45 \times 8\] 
32. \[38 \times 9\] 
37. \[67 \times 4\] 
33. \[45 \times 9\] 
38. \[97 \times 5\] 
34. \[67 \times 3\] 
39. \[92 \times 6\] 
35. \[85 \times 7\] 
40. \[35 \times 9\]
41. 83 x 5
42. 24 x 6
43. 64 x 7
44. 95 x 8
45. 72 x 5
46. 69 x 4
47. 35 x 8
48. 79 x 4
49. 25 x 9
50. 46 x 3
Appendix C
Worksheet Three on Colored Paper

Directions: Complete as many problems as you can.

1. \[29 \times 6\] 11. \[82 \times 3\] 21. \[95 \times 3\] 31. \[96 \times 4\] 41. \[27 \times 9\]

2. \[57 \times 6\] 12. \[27 \times 4\] 22. \[43 \times 7\] 32. \[93 \times 6\] 42. \[72 \times 3\]

3. \[39 \times 5\] 13. \[35 \times 4\] 23. \[76 \times 5\] 33. \[54 \times 3\] 43. \[56 \times 4\]

4. \[62 \times 3\] 14. \[65 \times 2\] 24. \[54 \times 9\] 34. \[58 \times 6\] 44. \[43 \times 8\]

5. \[89 \times 6\] 15. \[53 \times 4\] 25. \[98 \times 5\] 35. \[98 \times 6\] 45. \[79 \times 3\]

6. \[54 \times 8\] 16. \[94 \times 7\] 26. \[93 \times 2\] 36. \[45 \times 2\] 46. \[93 \times 8\]

7. \[52 \times 3\] 17. \[49 \times 3\] 27. \[47 \times 5\] 37. \[87 \times 6\] 47. \[34 \times 6\]

8. \[86 \times 9\] 18. \[73 \times 4\] 28. \[96 \times 3\] 38. \[86 \times 3\] 48. \[67 \times 5\]

9. \[45 \times 7\] 19. \[98 \times 7\] 29. \[64 \times 8\] 39. \[79 \times 2\] 49. \[37 \times 8\]

10. \[37 \times 2\] 20. \[83 \times 6\] 30. \[53 \times 6\] 40. \[45 \times 3\] 50. \[39 \times 2\]
Appendix D

Worksheet Four on Colored Paper

Name: _________________________    Date: __________ _________

Directions: Complete as many problems as you can.

1.  49  
   \[ \times 5 \]  
   \[ 62 \]

2.  58  
   \[ \times 7 \]  
   \[ 97 \]

3.  36  
   \[ \times 2 \]  
   \[ 64 \]

4.  53  
   \[ \times 7 \]  
   \[ 89 \]

5.  82  
   \[ \times 7 \]  
   \[ 36 \]
11. \[ \begin{array}{c}
82 \\
\times 9
\end{array} \]
16. \[ \begin{array}{c}
58 \\
\times 4
\end{array} \]

12. \[ \begin{array}{c}
39 \\
\times 4
\end{array} \]
17. \[ \begin{array}{c}
74 \\
\times 4
\end{array} \]

13. \[ \begin{array}{c}
87 \\
\times 9
\end{array} \]
18. \[ \begin{array}{c}
48 \\
\times 7
\end{array} \]

14. \[ \begin{array}{c}
54 \\
\times 7
\end{array} \]
19. \[ \begin{array}{c}
79 \\
\times 6
\end{array} \]

15. \[ \begin{array}{c}
78 \\
\times 2
\end{array} \]
20. \[ \begin{array}{c}
69 \\
\times 2
\end{array} \]
21. \[57 \times 3\]  
22. \[28 \times 7\]  
23. \[36 \times 4\]  
24. \[45 \times 5\]  
25. \[92 \times 8\]  
26. \[63 \times 9\]  
27. \[76 \times 8\]  
28. \[65 \times 9\]  
29. \[27 \times 6\]  
30. \[96 \times 8\]
31. $48 \times 3$

36. $86 \times 4$

32. $62 \times 4$

37. $23 \times 4$

33. $26 \times 4$

38. $38 \times 4$

34. $62 \times 9$

39. $29 \times 3$

35. $53 \times 9$

40. $93 \times 4$
41.  58  
    x 3  

42.  63  
    x 2  

43.  97  
    x 3  

44.  96  
    x 2  

45.  42  
    x 6  

46.  47  
    x 8  

47.  59  
    x 6  

48.  82  
    x 4  

49.  48  
    x 6  

50.  89  
    x 2
Appendix E

Example Performance Score Table

<table>
<thead>
<tr>
<th>Name</th>
<th>Sheet</th>
<th># Correct</th>
<th># Attempted</th>
<th># Incorrect</th>
<th>% Correct/50</th>
<th>% Correct/Attempted</th>
<th>Overall Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student A</td>
<td>1</td>
<td>8</td>
<td>9</td>
<td>1</td>
<td>16%</td>
<td>89%</td>
<td>53%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>7</td>
<td>11</td>
<td>4</td>
<td>14%</td>
<td>63%</td>
<td>39%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>11</td>
<td>17</td>
<td>6</td>
<td>22%</td>
<td>65%</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>10</td>
<td>14</td>
<td>4</td>
<td>20%</td>
<td>71%</td>
<td>46%</td>
</tr>
<tr>
<td>Student B</td>
<td>1</td>
<td>7</td>
<td>14</td>
<td>7</td>
<td>14%</td>
<td>50%</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>14</td>
<td>16</td>
<td>2</td>
<td>28%</td>
<td>88%</td>
<td>58%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>16</td>
<td>17</td>
<td>1</td>
<td>32%</td>
<td>94%</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>14</td>
<td>14</td>
<td>0</td>
<td>28%</td>
<td>100%</td>
<td>64%</td>
</tr>
<tr>
<td>Student C</td>
<td>1</td>
<td>19</td>
<td>20</td>
<td>1</td>
<td>38%</td>
<td>95%</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>23</td>
<td>25</td>
<td>2</td>
<td>46%</td>
<td>92%</td>
<td>69%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>15</td>
<td>38</td>
<td>23</td>
<td>30%</td>
<td>39%</td>
<td>34%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>19</td>
<td>24</td>
<td>5</td>
<td>38%</td>
<td>79%</td>
<td>59%</td>
</tr>
</tbody>
</table>
Appendix F
Participant Responses

<table>
<thead>
<tr>
<th>Worksheet One: 16 Votes</th>
<th>Worksheet Two 10 Votes</th>
<th>Worksheet Three 11 Votes</th>
<th>Worksheet Four 15 Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easier</td>
<td>More Room</td>
<td>Easier</td>
<td>More Room</td>
</tr>
<tr>
<td>Easier</td>
<td>More Room</td>
<td>Seemed Larger</td>
<td>More Room</td>
</tr>
<tr>
<td>Seemed Larger</td>
<td>More Room</td>
<td>No Flipping</td>
<td>More Room</td>
</tr>
<tr>
<td>No Flipping</td>
<td>Could see the problems better</td>
<td>No Flipping</td>
<td>Larger Font and seemed like less problems</td>
</tr>
<tr>
<td>Easier</td>
<td>More Work Space</td>
<td>Easier</td>
<td>More Room</td>
</tr>
<tr>
<td>No Flipping</td>
<td>Easier to tell what # you are on, and the White paper made the black font stand out</td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td>No Flipping</td>
<td>More room and thought the blue paper was distracting</td>
<td>No Flipping</td>
<td>See the problems better</td>
</tr>
<tr>
<td>No Flipping</td>
<td>More room and could see the problems easier</td>
<td>No Flipping</td>
<td>Bigger Font</td>
</tr>
<tr>
<td>No Flipping</td>
<td>More room</td>
<td>No Flipping</td>
<td>More work space</td>
</tr>
<tr>
<td>Because it was first</td>
<td>Seemed easier</td>
<td>No Flipping</td>
<td>More room and blue paper wasn’t as bright as the while paper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room and could see the problems easier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>Larger font but wished the problems were all on one page</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>Had more practice from the previous worksheets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liked the color and did not need more space for work</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More room</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Flipping</td>
<td>More room</td>
</tr>
</tbody>
</table>