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Use of the Self-Monitoring Strategy among Students with Attention Deficit Hyperactivity Disorder: A Systematic Review

Areej Alsalamah
Department of Teaching and Learning, Washington State University
1248, SE LATAH ST. #17, Pullman 99163 Washington

Abstract
This article provides a systematic review of self-monitoring studies published between 2000 and 2016 in order to investigate the effectiveness of implementing a self-monitoring strategy to improve the outcomes of students with Attention Deficit Hyperactivity Disorder (ADHD). A total of nine articles and dissertations were located and reviewed. The findings revealed that most of the students with ADHD in these studies showed improvement in their on-task behavior and academic outcomes after participating in a self-monitoring intervention. Future studies should be conducted to confirm the studies' findings outlined here.
Keywords: Attention Deficit Hyperactivity Disorder, Self-monitoring intervention, Self-monitoring strategy

1. Introduction

Numerous studies have been published recently examining the nature of Attention Deficit Hyperactivity Disorder (ADHD), which is a common behavioral disorder that impedes students from developing suitable social behavior and academic achievement (Kulkarni 2015). In fact, according to the Centers of Disease Control and Prevention (2017), in 2011 the aggregate number of children who were diagnosed with ADHD in the US reached 6.4 million. ADHD is a persistent neurodevelopmental disorder generated by compound interactions among genes, environmental impacts, and changes in brain development (Paidipati *et al.* 2017). It was defined by the Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM V) as "a persistent pattern of intention and/or hyperactivity-impulsivity that is more frequently displayed and more severe than is typically observed in individuals at a comparable level of development" (American Psychiatric Association 2013, p.61). Students who are diagnosed with ADHD show diverse symptoms, which comprise three main components: inattention (inability to maintain focus), hyperactivity (excessive movement that is not appropriate to the setting), and impulsivity (action without thinking about the results) (American Psychiatric Association 2017). The American Psychiatric Association (2013) via DSM V emphasizes that adults present with these symptoms differently from children. Through the early years of childhood, ADHD symptoms are evident in excessive motor activities; when children join elementary school, the inattentive behavior becomes obvious. However, the motor activities, such as running and climbing, tend to disappear through adulthood, while impulsivity remains, together with some other symptoms (for instance, restlessness, inattention, poor planning, an inner feeling of jitteriness, restlessness, and impatience). Generally, academic problems constitute a common symptom in individuals of different ages with ADHD.

Students with ADHD can display significant reduction in their academic performance. Birchwood & Daley (2012) studied the impact of ADHD symptoms on academic performance in 324 students between 15 and 16 years of age. The results indicated that students who are diagnosed with a high level of ADHD symptoms have lower achievement rates than students without ADHD. In another comparison study, Kent *et al.* (2011) compared two groups of students in high schools (326 students with ADHD and 213 students without ADHD). The results showed that the students with ADHD experienced severe academic challenges; in this sense, they had the lowest achievement rates, with a higher rate of course failure than students without ADHD. Furthermore, they were vulnerable to absenteeism or school dropout. These results were also confirmed by a longitudinal study carried out by Scholtens *et al.* (2013), who investigated the long-term relationship between ADHD symptoms and academic achievement among 192 students with ADHD. Data was collected for these students in three different grades: 6^{th}, 11^{th}, and 12^{th} grade. The authors concluded that the symptoms of ADHD affected academic achievement negatively in all grades. Additionally, the students' academic self-perception in 11^{th} grade and future orientation in 12^{th} grade were negatively influenced by these symptoms. However, educators recognize that ADHD symptoms are not the result of defiant behavior or a lack of understanding, and therefore they use different strategies in schools to control unacceptable behavior that exists among students diagnosed with ADHD, such as an inability to stay on task, a lack of persistence, disorganization, restlessness, excessive talking, and interference in activities or conversations (Rivera-Flores 2015).

1.1. Self-Monitoring Strategy

The self-monitoring strategy is one of the promising strategies that educators have recently used to support students diagnosed with ADHD to cope with their symptoms. This strategy was developed via social cognitive behavior theory, and it involves individuals' recording their own practices or their own behavior systematically

in order to improve practices (Oliver *et al.* 2015). The self-motivating strategy has also been defined as a secondary strategy to utilize in order to prevent inappropriate behavior by training students to observe and record their behavior independently so they can decide if they are engaging in a target behavior at a particular time so that their academic, behavioral, and social skills are being developed (Bell *et al.* 2013). Using this strategy, therefore, individuals think about and record their behavior by comparing their accomplishments to specified performance.

The implementation of the self-monitoring strategy has been recommended in different studies to improve academic and behavioral performance in students, especially for those who have special needs. Joseph & Eveleigh (2011) discussed the effectiveness of the self-monitoring strategy in improving reading performance by reviewing 16 studies that examined implementation amongst students with special needs, and the findings showed that reading performance can be improved using the self-monitoring strategy. Additionally, by using this strategy, educators can support students with disabilities in achieving a significant increase in math achievement and time management. McDougall *et al.* (2012) studied the effectiveness of implementing the self-monitoring strategy via MotivAider in improving algebra skills and reducing the time needed to complete tasks among students with disabilities who were divided into two groups: The first group included one student with ADHD in 10th grade who was taught self-monitoring to improve his algebra skills whereas the second group included five students in 9th grade with an emotional disturbance who were taught self-monitoring to reduce the time that they spent completing English tasks. The results of the study indicated that using self-monitoring improved academic productivity amongst students with special needs during independent tasks.

Other studies have supported the use of the self-monitoring strategy to influence students' behavior. For example, Sheffield & Waller (2010) examined the efficacy of using the self-monitoring strategy to reduce unacceptable behavior in the classroom. This study included 16 studies that utilized single-subject designs to identify the effect of implementing the self-monitoring strategy. The results suggested that using the self-monitoring strategy is a positive behavioral intervention when used alone or with other components by educators to improve students' behaviors. In addition, Boswell *et al.* (2013) reported that the self-monitoring strategy is an effective strategy to use with students who have disabilities. They investigated the impact of the self-monitoring strategy on developing the on-task behavior of three students in 5th and 6th grade, two of whom were diagnosed with autism and one with cerebral palsy. The on-task performance increased for all the students after the self-monitoring strategy was employed via MotivAider. Whereas the implementation of the self-monitoring strategy was examined in various studies that included students with different types of disabilities, limited systematic studies have been done to investigate the effectiveness of the implementation of the self-monitoring strategy with students who have ADHD. Furthermore, there is a need to identify how the outcomes of students with ADHD can be impacted by implementing the self-monitoring strategy. Therefore, the primary purpose of this systematic review is to answer the following four questions:

1. What are the key characteristics of the students who were included in the self-monitoring studies (number, gender, grades, and disabilities)?
2. How are self-monitoring studies designed to examine the validity of the interventions?
3. Was the implementation of the self-monitoring intervention synchronized with other kinds of interventions?
4. What are the significant outcomes of self-monitoring studies?

2. Method

To gain additional knowledge about the effectiveness of self-monitoring strategy implementation in enhancing the outcomes of students who have ADHD, a systematic literature review was conducted. For this systematic review, three steps were followed to locate potential articles. First, studies were collected using three electronic databases to include Education Resources Information Center (ERIC), Elton B. Stephens COmpany (EBSCO), and SAra and GEorge (SAGE) Journals. Second, the studies had to use a single-subject study design in investigating the effectiveness of implementing self-monitoring interventions to improve academic and behavioral achievements in students with ADHD. Third, the studies were to be published between January 2000 and December 2016 in educational and behavioral journals.

The three electronic databases (ERIC, EBSCO, and SAGE) were selected as major sources of the articles that were included in this systematic review because they provided access to the full text of the publications, most of which were published in peer-reviewed journals. The study was limited to a single-subject study design because it was a scientifically effective method that could be used to assess the effectiveness of interventions designed to promote or address the target students' behavior and a gap within the literature was evident. The What Works Clearing house (2010) recommended single subject research methods as an evidence-based practice that enabled educators to collect data and monitor students' responses in order to make decisions about the students' behavior. Moreover, the earliest article selected was published in 2000. So articles that were published during the 1990s were not included. That was because articles of that nature had already been

discussed in two previous review studies by Barry & Haraway (2005), and Briesch & Chafouleas (2009).

2.1. Article Selection Process

The search was conducted using four main search terms in electronic databases: self-monitoring, self-monitoring strategy, self-monitoring intervention, self-monitoring and ADHD, and self-monitoring and Attention Deficit Hyperactivity Disorder. Of the 269 studies found, nine articles met the criterion and were selected after reading the studies' titles and abstracts. The nine selected studies had been published in eight different journals: *Behavior Analysis in Practice, Behavior Modification*, *Education and Treatment of Children, Behavioral Disorders, Journal of Behavioral Education, Journal of College Teaching & Learning, Journal of Positive Behavior Interventions*, and *The Journal of Special Education.* These journals provide high quality educational and behavioral research for target professional audiences includes researchers, practitioners, and academics. Studies that contained other terms such as self-control, self-management, self-determination, and self-report without clear definition were excluded, along with studies that did not provide enough information about the participants. Figure 1 displays a visual representation of the procedural selection of publications.

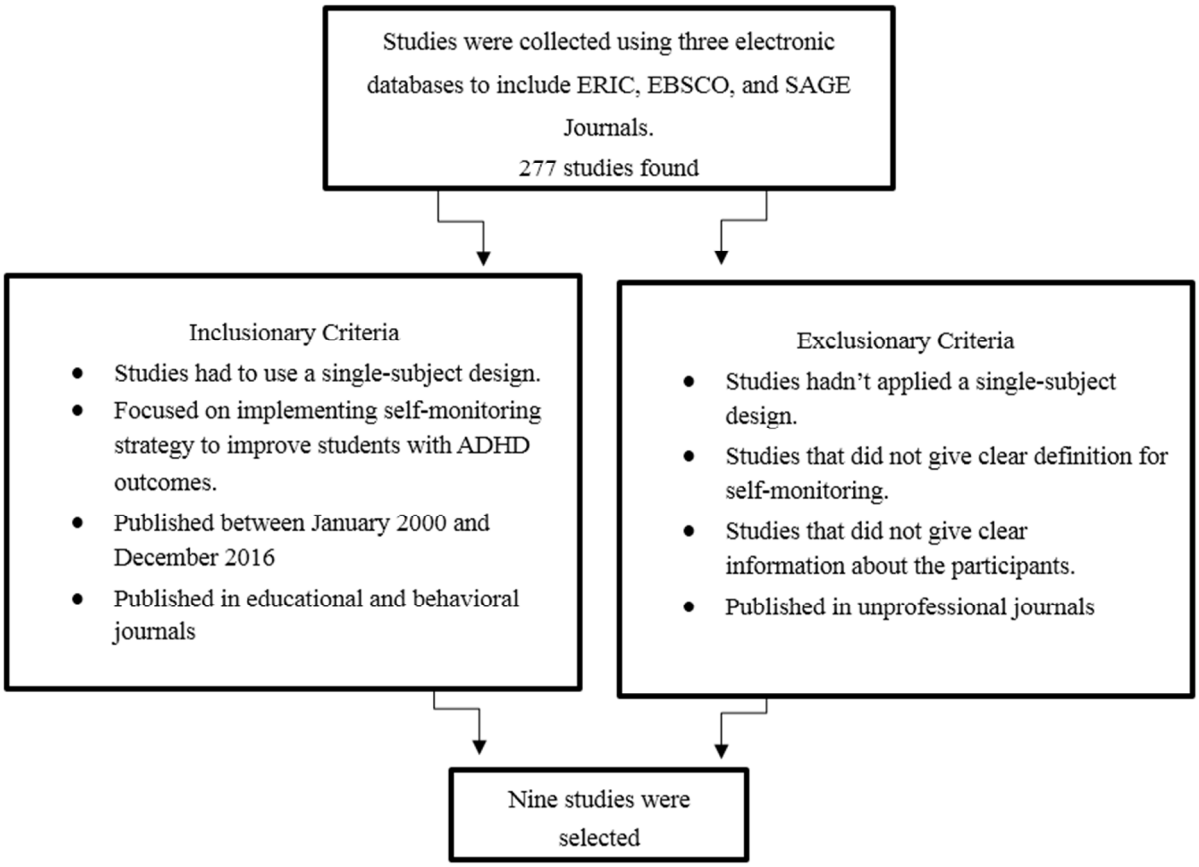

Figure 1. Summary of the Systematic Review Procedural Selection of Publications Single-Subject

2.2. Coding Procedures

The nine studies in which the independent variable was the self-monitoring strategy were examined in depth in six areas: (a) characteristics of the participants (i.e., gender, gender, grades, and disabilities) (b) school setting (i.e., general education classroom, special education classroom), (c) study design (i.e., Single-subject design: alternating treatment design, ABAB, multiple-baseline design), (d) interventions (i.e., self-monitoring strategy, medication, reinforcement), (e) dependent variables (i.e., educational skills, behavior skills), and (f) study outcomes. The findings were entered into a table according to authors' name and the year of publication. After reviewing the findings new information was added if required.

3. Findings

To investigate the research questions, nine studies were examined according to specific aspects. Table 1 illustrates the summary of the studies and dissertations that discussed the effectiveness of implementing the self-monitoring strategy to improve the outcomes of students with ADHD.

3.1. Characteristics of the Participants and Schools Settings

The participants in the nine studies included 24 students (17 males and 7 females). All but two students who were considered to be at risk were diagnosed with ADHD whereas a one of the student in these studies was diagnosed with emotional disorders in addition to ADHD (Stahr *et al.* 2006). The students in these studies ranged in grade: 54% of them were in elementary school, 17% were in middle school, and 29% were in high school. The students received the intervention in a general education classroom setting in eight studies, with one school implementing a school-wide intervention (Graham-Day *et al.* 2010). Just one student in one study received the intervention in a special education setting, which was an independent school for students with EBD (Stahr *et al.* 2006).

3.2. Research Design

To examine the effectiveness of implementing the self-monitoring strategy to enhance outcomes among students with ADHD, all nine studies employed a single-subject study design due to single subject research designs are considered to be part of the evidence-based practices according to the What Works Clearinghouse (2010). Hence, this study focused on using this research design as the means to compare the effects of the self-monitoring strategy for students with ADHD. Three of the studies in this systematic review utilized the ABAB design (Bruhn & Watt 2012; Wills & Mason 2014; Vogelgesang *et al.* 2016). One of them applied the ABC alternating treatment design (Graham-Day *et al.* 2010), whereas the rest of the studies used a multiple-baseline design across settings (Stahr *et al.* 2006) or a multiple-baseline design across participants (Harris *et al.* 2005; Gureasko-Moore *et al.* 2006; Rafferty *et al.* 2011; Morrison *et al.* 2014). Details about the treatment fidelity were provided in seven studies, whereas one study mentioned treatment fidelity without including any percentages or documents, and in the remaining study it was not discussed at all.

Table 1. Summary of the studies and dissertations

Author(s)	Design	(n) & Gender	Grade(s)	School Setting	Interventions	Results
Bruhn & Watt (2012)	Single-subject design (ABAB)	(2) 1 of them with ADHD All Females	8	General education classroom	Medication for ADHD Self-monitoring strategy using a checklist	Students' engagement in reading classes increased. Disruptive behavior declined.
Graham-Day *et al.* (2010)	Single-subject (alternating treatment design)	(3) 2 males, 1 female	10	General education classroom under a classroom-wide intervention	Medication for ADHD Self-monitoring strategy using a checklist Reinforcement (candy)	Students' on-task behavior increased. Using reinforcement with self-monitoring to support students in on-task behavior was more effective than using self-monitoring alone. Grades were lower than at the beginning of the study.
Gureasko-Moore *et al.* (2006)	Single-subject design (a multiple-baseline design across participants)	(3) All Males	7	Independent classroom for training General education classroom for practicing	Medication for ADHD Self-monitoring strategy using a checklist Self-management plan Self-evaluation Self-reinforcement	Students' classroom preparation behavior increased. Using reinforcement with self-monitoring to support students in on-task behavior was more effective than using self-monitoring alone.
Author(s)	**Design**	**(n) & Gender**	**Grade(s)**	**School Setting**	**Interventions**	**Results**
Harris *et al.* (2005)	Single- subject design (a multiple-baseline design across participants)	(6) 5 males, 1 female	3, 4, 5 1 student in grade 3, 2 students in grade 4, 3 students in grade 5	General education classroom	Medication for ADHD Self-monitoring strategy using a checklist	Students' on-task and preparedness behavior increased. Students' spelling performance improved.
Morrison *et al.* (2014)	Single-subject (a multiple-baseline design across participants)	(2) 1 male, 1 female	9	General education classroom	Tactile-cued self-monitoring using sheets and the MotivAider device	Students' performance improved on independent biology tasks.
Rafferty *et al.* (2011)	Single subject (a multiple-baseline design across participants)	(5) 3 of them had ADHD 2 males, 1 female	5	Independent classroom for training General education classroom for practicing	Self-monitoring strategy using cards	Students' on-task behavior improved. Students' spelling accuracy improved.
Author(s)	**Design**	**(n)&Gender**	**Grade(s)**	**School Setting**	**Interventions**	**Results**
Stahr *et al.* (2006)	Single-subject design (a multiple-baseline design across settings)	(1) Male In addition to ADHD, he had emotional disorders.	4	Independent school for students who have EBD	Medication Self-monitoring strategy using a checklist Communication system using colored cards	Students' on-task behavior improved in language arts and math.
Vogelgesang *et al.* (2016)	Single-subject design (ABAB)	(3) 1 male, 2 females 1 of them was diagnosed with ADHD, whereas the others were at risk	5	General education classroom	Self-monitoring strategy using the SCORE IT application via an iPad device	Students' academic engagement improved.
Wills & Mason (2014)	Single-subject design (ABAB)	(2) Males	9	General education classroom	Medication for ADHD Self-monitoring strategy using the I-Connect application via a mobile device	Students' on-task behavior improved. No clear improvement in the students' disruptive behavior was observed

3.3. Intervention Components

The main intervention in all nine studies was the self-monitoring strategy; however, the studies implemented this strategy using different tools. In five of the studies, the researchers used a checklist to implement the self-monitoring strategy (Harris *et al.* 2005; Gureasko-Moore *et al.* 2006; Stahr *et al.* 2006; Graham-Day *et al.* 2010; Bruhn & Watt 2012). One study used cards (Rafferty *et al.* 2011). The self-monitoring strategy was implemented in two studies through applications using electronic devices such as an iPad or another mobile device (Wills & Mason 2014; Vogelgesang *et al.* 2016). Additionally, one study implemented the strategy using the MotivAider device (Morrison *et al.* 2014).

The self-monitoring strategy was implemented as the only independent variable in three of the studies (Rafferty *et al.* 2011; Morrison *et al.* 2014; Vogelgesang *et al.* 2016) whereas all the other studies mentioned that the students were taking medication to control their ADHD symptoms. In Gureasko-Moore *et al.*'s (2006) study, in addition to the self-monitoring strategy and medication, the students used other strategies such as self-management, self-evaluation, and self-reinforcement. Furthermore, Graham-Day *et al.* (2010) reinforced the students in their study by giving them candy. Finally, colored cards were used in Stahr *et al.* (2006) study as part of a communication system that was employed while they implemented the self-monitoring strategy.

3.4. Self-Monitoring Outcomes

In general, the outcomes of all nine studies showed that implementing the self-monitoring strategy can elicit positive outcomes for students with ADHD. Specifically, three studies confirmed that students' academic performance improved in spelling (Harris *et al.* 2005; Rafferty *et al.* 2011) and biology (Morrison *et al.* 2014). However, students' academic performance did not improve in one of the studies (Graham-Day *et al.* 2010). Another important finding was that using the self-monitoring strategy improved on-task behavior among students with ADHD (Harris *et al.* 2005; Stahr *et al.* 2006; Graham-Day *et al.* 2010; Rafferty *et al.* 2011; Bruhn & Watt 2012; Wills & Mason 2014; Vogelgesang *et al.* 2016). Additionally, according to Bruhn & Watt (2012), disruptive behavior declined among students after using the self-monitoring strategy. In contrast, Wills & Mason (2014) found no clear improvement in students' disruptive behavior. Finally, two of the studies mentioned that using reinforcement with self-monitoring to support students in on-task behavior was more effective than using self-monitoring alone (Gureasko-Moore *et al.* 2006; Graham-Day *et al.* 2010).

3.5. Limitations from the Literature

Despite the positive outcomes of these self-monitoring studies, there are some research limitations to consider. An important limitation is that the self-monitoring intervention was used over a short period, during the school day, and in a specific school setting. In this sense, the studies did not investigate if the students who employed the self-monitoring strategy were able to generalize it to different settings. Another limitation is that the self-monitoring intervention components studied were applied to different components such as self-control, self-evaluation, and reinforcement. Furthermore, these components were delivered using different tools, such as electronic devices and checklists. In addition, most of the students in the studies received medical intervention to control their ADHD symptoms. Given all the above limitations, two of the studies showed that the self-monitoring strategy did not affect students' outcomes.

4. Discussion

Based on this systematic review of nine studies, the results support the implementation of the self-monitoring strategy to improve academic performance and on-task behavior among students who have ADHD. The researchers demonstrated this by using single-subject designs to examine the influence of the self-monitoring strategy on students' outcomes. The results of this study support the positive outcomes of previous literature review studies in self-monitoring (Sheffield & Waller 2010; Joseph & Eveleigh 2011); in these studies, students' performances increased in response to self-monitoring strategy intervention.

Besides the self-monitoring strategy being easy to implement, effective, and inexpensive (Levendoski & Cartledge 2000), it has also been recommended via a myriad of research studies for several reasons. For example, it can be used by students of various ages in different educational settings (Webber *et al.* 1993); the studies included in this systematic review reflected that the implementation of the self-monitoring strategy was applicable in both general and special educational settings to improve students' outcomes at elementary, middle, and high schools. Additionally, educators have suggested utilizing the self-monitoring strategy to develop students' awareness about their behavior in addition to how such behavior can impact on their performance, which can then enable them to identify and augment acceptable behavior (Hulac *et al.* 2011) by comparing their accomplishments to specified performance (Oliver *et al.* 2015). Further, the strategy also supports teachers in reducing the length of time that students spend on doing tasks (Lan *et al.* 1998). In general, the results of the studies reviewed in this systematic review confirm that monitoring students' target behavior before and after implementing the self-monitoring strategy eventually leads to an increase in students' behavioral and academic

outcomes.

However, the results of this review study call for educators to pay attention to some important points. Firstly. the self-monitoring strategy requires individual training, so it cannot be used with large classes (Bell *et al.* 2013). Moreover, the relationship between self-monitoring, on-task behavior, and academic performance is not clear, and it is unknown if students with special needs can use the self-monitoring strategy efficiently while learning new concepts and skills (Levendoski & Cartledge 2000). This elicits an important question of whether academic performance can be increased by using the self-monitoring strategy alone.

4.1. Limitations

Despite the positive outcomes of this systematic review, there are some limitations. Nine studies were included based on available electronic databases, therefore, research papers that were not published electronically were not included. In this sense, some studies used a checklist or electronic devices, while others used different strategies beside the self-monitoring strategy. A limitation of the present study is that the research designs of the nine studies reviewed were limited to single-subject designs, and studies that examined the effect of using the self-monitoring strategy by using two groups were not included.

5. Implications for Research and Practice

Over the past 40 years, researchers have encouraged educators to implement self-monitoring strategies to improve social and behavioral student outcomes (Morrison *et al.* 2014). The results of this systematic review study support the implementation of the self-monitoring strategy for students with ADHD. However, further research is necessary to check the validity of implementing the self-monitoring strategy alone to improve the outcomes of students who have ADHD but do not receive medical intervention. Additionally, future studies are required to determine the most effective components and means of implementing the self-monitoring strategy and whether the use of technology affects the implementation. Researchers could investigate these topics using control and experimental groups; with this method, they can distinguish the positive results attained in response to the intervention from the extraneous variables (Chitiyo 2014).

Similarly, exploring how educators can support students in the generalization of self-monitoring in different settings would improve the value of this strategy. Students are likely to implement this strategy in the future if they enhance self-monitoring in different settings (Ganz 2008). It is also important to determine whether the students' implementation of a self-monitoring strategy will improve if the students get training in large or small groups by primary teachers or other teachers (Reid *et al.* 2014). All of these factors can impact the implementation of the self-monitoring strategy and generalization, which can trigger more questions about the application of the strategy.

The samples of most of the studies that have examined the effects of the self-monitoring strategy have included elementary school students, but few of them have included middle school and high school students. High school students who have ADHD confront many challenges regarding the lack of self-monitoring. They may leave without any intervention because educators expect them to be able to guide themselves in different academic settings (Graham-Day *et al.* 2010).

Finally, developing teachers' skills through in-service training to enable them to deal with students who have ADHD is a fundamental necessity for implementing successful intervention. Indeed, 76% of general education teachers and 41% of special education teachers reported that they received little or no in-service training in the application of approaches to controlling ADHD symptoms (Martinussen *et al.* 2011). Thus, special training is necessary to enable teachers to plan and to apply reliable interventions. To response to students with ADHD characteristics teachers should develop goal-setting skills and explicit instruction which should be synchronized with capability in collecting data about students' progress (Bak & Asaro-Saddler 2013). Furthermore, teachers should note that they can develop attractive interventions to enhance self-monitoring strategies by using strategies such as MotivAider or iPod. However, circumspection is required to ensure that students know how to use devices to monitor themselves successfully in the achievement of their word-target goals (Lewandowski *et al.* 2016). In sum, undertaking more studies will lead to improved educational practices, enhancing the teaching and learning of students with ADHD.

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Author biography

Areej Alsalamah, BA and MA in Learning Disabilities from King Saud University, Saudi Arabia. She is lecturer at Special Education Department in Education Collage at King Saud University since; she is a PhD student in Learning Disabilities at the Department of Teaching and Learning, Washington State University in the USA.