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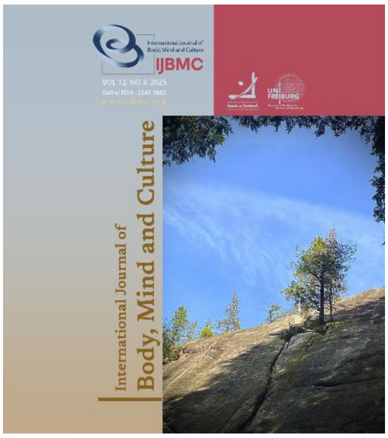

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The Effectiveness of The Self-Monitoring of Attention Educational Program on Concentration and Cognitive Flexibility in Students with Specific Learning Disabilities

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ABSTRACT

Objective: This study aimed to evaluate the effectiveness of a self-monitoring attention training program on improving concentration and cognitive flexibility among elementary school students diagnosed with mathematical learning disabilities.

Methods and Materials: The research method employed a semi-experimental pre-test-post-test design with experimental and control groups, followed by a three-month follow-up period. The statistical population consisted of female students with mathematical learning disabilities in the first grade who were referred to the Boroujerd City Disorders Center during the 2023-2024 academic year. The research sample consisted of 30 female students who were randomly selected based on the entry criteria and divided into two groups: experimental and control (15 students in each group). The experimental group received 12 sessions of the attention self-monitoring training program. The Wechsler Intelligence Scale for Children-IV and the Wisconsin Card Sorting Test (WCST) were used to collect data. Data analysis was performed using repeated measures analysis of variance in SPSS 27 software.

Findings: The results showed a statistically significant difference in scores for concentration and cognitive flexibility between the experimental and control groups in students with specific learning disabilities ($p \leq 0.01$). This finding persisted during the three-month follow-up period.

Conclusion: Overall, the results of the present study highlight self-monitoring of attention as a promising strategy and point of improvement for concentration and cognitive flexibility, which can be utilized to address cognitive problems (specifically, concentration and cognitive flexibility) in students with specific learning disabilities.

Keywords: Students, Attention, Cognition, Learning Disabilities.

Introduction

Specific learning disabilities are categorized as subgroups of neurodevelopmental disorders, characterized by severe difficulties in reading (dyslexia), written expression disorder, and/or mathematics disorder (American Psychiatric Association, 2024). Mathematics disorder, which is the focus of this study, involves difficulties in understanding or learning mathematical computations (Learning Disabilities Association of America, 2021). The estimated prevalence of mathematical learning disabilities globally ranges from 3% to 8% (Kroesbergen et al., 2023). Although there are no precise statistics on the prevalence of mathematics disorder among children in Iran, a study found that 3.6% of children in Tehran were affected by this disorder (Hamid, 2005). Due to the prevalence and persistence of mathematical learning disabilities, collecting evidence on the (cognitive) characteristics of children with this disorder is of great importance to ensure that education and interventions are tailored to their needs.

According to Salihu et al., gender differences do not affect students' mathematical progress (Salihu et al., 2018). However, living conditions and socioeconomic status have a significant influence on students' mathematical abilities. Reading comprehension and students' understanding are strong primary determinants of learning difficulty levels. Additionally, students' educational background, which includes skills acquired through years of previous education, can also be considered a determining factor in their mathematical abilities (Skoumios & Skoumpourdi, 2021). Mathematical skill issues can be linked to reading comprehension, numerical understanding, concentration, accuracy, and the reading context of students (Anobile et al., 2021; Lee & Lee, 2020).

Concentration has been identified as the most important factor for successful performance (Sanchez & Torregrosa, 2005). It refers to an individual's ability to direct their thoughts in alignment with their intent and purpose (Gunaratana, 2010). Concentration deficits are a primary characteristic of attention deficit hyperactivity disorder (ADHD) in childhood. Children affected by ADHD often struggle with learning mathematics due to their weak memory and difficulty in maintaining focus on external stimuli (Rosenfeld, 2019; Stanford & Delage, 2020). According to Rosenfeld, "Intense concentration on a single task requires a significant amount of mental energy, which often conflicts with the tendency of many children with ADHD for constant shifting stimulation. This is why completing a mathematical proof or solving a problem involving complex procedures may seem unattainable for these children" (Rosenfeld, 2019). Children with ADHD are considered to have a neurological disorder that may manifest as hyperkinetic activity and/or difficulty in focusing. They tend to exhibit inattentive, hyperactive, or impulsive behaviors, which highlight the need for caregiver support and treatments such as medication or behavioral interventions (Remata & Lomibao, 2021).

Cognitive flexibility in solving mathematical problems is another variable considered in this study. Cognitive flexibility refers to the ability to shift between different modes of thinking and adapt to new or changing environments (Zmigrod et al., 2019). Like other executive functions, it can be associated with mathematical performance. According to existing theoretical background, cognitive skills related to executive functions are essential for academic performance, and deficits in these skills reduce the likelihood of success. Executive functions, defined as distinct but interconnected neurocognitive processes, are self-regulatory abilities that enable goal-oriented control of thoughts and behaviors related to organization, task planning, and voluntary cognitive action. Thus, executive skills such as remembering and retaining information (working memory), suppressing distractions (inhibitory control), and the ability to switch between different states (cognitive flexibility) are crucial for the learning process (Wilkey et al., 2020). To enhance efficiency in mathematics, students must utilize their cognitive flexibility to assess and select strategies without persisting in their mistakes. Recent studies show that children with higher levels of cognitive flexibility score better in basic numerical skills and number comprehension, including whole numbers, fractions, decimals, and integers (de Santana et al., 2022). According to Cragg and Chevalier, cognitive flexibility plays a role in finding creative alternatives to problems, as it involves generating and selecting innovative work strategies (Cragg & Chevalier, 2012). This highlights the importance of implementing therapeutic and educational interventions to enhance cognitive flexibility, which in turn improves mathematical skills.

Self-monitoring of attention is a cognitive-behavioral therapy technique and a subset of self-management strategies that has been successfully applied among students in various educational settings. This process involves systematic observation and self-recording of one's behavior. Self-monitoring of attention refers to the learner's evaluation of the occurrence of a targeted behavior and the recording of its outcomes (Hallahan & Hudson, 2002; Hallahan et al., 2019). Self-monitoring is a process through which students become aware of their irregular behaviors and performance deficits and take steps to correct them. During this process, individuals are trained to record and control their behaviors (Adinugoroho, 2009). Theoretically, more efficient attention processes should lead to improvements in executive functions (Blaye & Chevalier, 2011; Paelecke-Habermann et al., 2005), including inhibition, task management, planning, monitoring, working memory, and encoding. Additionally, enhanced executive functioning should lead to behavioral improvements—for example, improved inhibition may enhance self-regulation (Tamm et al., 2013). The effectiveness of self-monitoring of attention training has been confirmed in numerous studies. For instance, Tamm et al. reported significant therapeutic effects of self-monitoring of attention training on concentration ability and executive functioning in children with ADHD (Tamm et al., 2013). A study by Dağgöl found a positive correlation between online self-regulated learning and cognitive flexibility (Dağgöl, 2023). Another survey of students with Down syndrome demonstrated that attention-concentration self-monitoring was effective in reducing inattentive behaviors and increasing precision and focus in these students (Noori et al., 2019). Melzer and Herwix also confirmed the effectiveness of self-monitoring interventions in improving attention among students with learning difficulties (Melzer & Herwix, 2024).

Overall, based on the reviewed literature, it can be stated that many students in primary and secondary education experience difficulties with mathematics. These difficulties can have significant consequences for their academic future and their ability to live independently in society. However, most studies have focused on students with learning disabilities in general, while fewer studies have specifically investigated students with mathematics-specific learning disabilities. Moreover, some researchers in applied cognitive neuroscience have advocated for the desirability of early interventions (Sonuga-Barke et al., 2011; Wass et al., 2012), suggesting that various types of interventions may be more effective for younger children. Nevertheless, little research has been conducted on self-monitoring of attention training in children with mathematics disorders. What is noteworthy is that self-monitoring of attention training, as a low-cost intervention, may also contribute to the acquisition of subsequent skills in other areas. This suggests that self-monitoring of attention training should be effective in improving cognitive performance across all domains (Wass et al., 2012).

Based on this, the main research question is formulated as follows: Does self-monitoring of attention training improve concentration and cognitive flexibility in elementary school students with specific learning disabilities?

Methods and Materials

Study Design and Participants

The present study employed a quasi-experimental, pre-test, post-test design with two groups (experimental and control) and a three-month follow-up period. The statistical population consisted of first-grade female students with mathematics learning disabilities who were referred to the Learning Disabilities Center in Borujerd during the 2023-2024 academic year. A sample of 30 eligible and willing students was selected using a random sampling method based on research criteria. These students were then randomly assigned to either the experimental group or the control group (15 students in each group). The experimental group underwent a 12-session self-monitoring of attention educational program.

The inclusion criteria included, confirmation of a specific mathematics learning disability diagnosis based on specialist evaluation and standardized tests such as the Wechsler Intelligence Scale and the KeyMath Test; obtaining the required score on the Raven's Standard Progressive Matrices Test (1936) (a minimum IQ score of 89 or higher) as a diagnostic criterion to confirm the absence of intellectual disability; first-grade female students aged between 7 years to 7 years and 9 months; full parental consent for participation; no diagnosis of autism spectrum disorder, ADHD, or other neurodevelopmental disorders as assessed through teacher interviews and medical records; absence of detectable physical or motor impairments; absence of acute physical illnesses as confirmed by teacher interviews; no medication use for learning disabilities in the past six months (verified through a checklist); and no diagnosis of co-occurring learning disabilities such as reading or writing disorders (confirmed by school records and Persian language evaluations). Exclusion criteria included missing more than two sessions during the intervention and lack of cooperation or withdrawal from the study.

Instruments

Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV): The WISC-IV is a revised version of the Wechsler Intelligence Scale for Children, developed initially by Wechsler (2003) for children aged 6 to 16 years. This test consists of 790 questions and follows a binary (0-1) scoring system. It includes 15 subtests (10 core subtests and five supplementary subtests), categorized into four indices: Verbal Comprehension (Similarities, Vocabulary, Comprehension, General Information, and Verbal Reasoning), Perceptual Reasoning (Block Design, Picture Concepts, Matrix Reasoning, and Picture Completion), Working Memory (Digit Span, Letter-Number Sequencing, and Arithmetic) and Processing Speed (Coding, Symbol Search). The test provides three main IQ scores (Verbal, Performance, and Full-Scale IQ) and five additional IQ scores: Verbal Comprehension, Perceptual Reasoning, Working Memory, Processing Speed, and Full-Scale IQ. For this study, the Picture Completion subtest (which consists of 38 cards) was used to assess concentration. In this task, the child is asked to identify the missing part of an image. The maximum response time for each item is 20 seconds. The reliability coefficients reported by Wechsler (2003) for the WISC-IV were as follows: Full-Scale IQ, 0.97; Verbal Comprehension Index, 0.94 (the highest reliability); and Processing Speed Index, 0.88 (the lowest reliability). For the subtests, the highest and lowest reliability coefficients were Vocabulary (0.92) and Comprehension (0.81), respectively. The concurrent validity of the WISC-IV was examined using correlation analysis with the WISC-III, yielding the following coefficients: Verbal Comprehension, 0.87; Perceptual Reasoning, 0.74; Working Memory, 0.72; and Processing Speed, 0.81 (Wechsler, 2003). In Iran, this test was translated, adapted, and standardized by Abedi et al. (2015) under the sponsorship of the Education Organization of Chaharmahal and Bakhtiari Province. The split-half and test-retest reliability coefficients for the Persian version ranged from 0.65 (Picture Concepts) to 0.94 (Vocabulary). The divergent validity was tested by correlating the scores of 30 participants with Raven's Progressive Matrices (1938) (r = 0.38) and the Wechsler Intelligence Scale for Children - Revised (1949) (r = 0.25). The strong inter-subtest correlations and the expected age-related increase in scores confirmed the convergent validity of this tool in Iran (Abedi et al., 2015).

Wisconsin Card Sorting Test (WCST): To assess cognitive flexibility, the computerized version of the Wisconsin Card Sorting Test (WCST) was used in this study. This test was initially developed by Grant and Berg (1948a) to measure executive functions, including selective attention, cognitive flexibility, abstract reasoning, and set-shifting ability. The WCST consists of two sets of 64 unique cards, each differing in: Shape (triangle, cross, circle, star), Color (green, blue, red, yellow), Number (one, two, three, or four symbols). Participants must categorize cards according to the dominant sorting rule (i.e., color, shape, or number), which changes unpredictably after a series of correct responses. After each attempt, the participant receives feedback indicating whether the response was correct or incorrect. The test terminates when either six categories are completed (Grant & Berg, 1948). The key performance metrics include: number of categories completed (measuring concept formation and concept retention) and perseverative errors (indicating difficulties in adapting to rule changes and cognitive inflexibility). In this test, achieving a category means that the participant has identified and applied a sorting rule correctly for 10 consecutive trials, with a maximum of six categories available. Perseverative errors occur when a participant repeatedly applies a previous rule despite receiving negative feedback, which reflects cognitive rigidity (Lezak et al., 2004). According to Heaton et al. (1993), the test-retest reliability of the 64-card version ranged from 0.37 to 0.72, as determined by Generalizability Theory. Grant and Berg (1948b) reported Pearson correlation coefficients of -0.25, -0.19, and -0.25 for total errors, perseverative errors, and non-perseverative errors, respectively, confirming the concurrent validity of the measures. In Iran, Shahgholian et al. (2012) examined the psychometric properties of the computerized version of WCST. The Cronbach's alpha reliability coefficients were: Completed categories: 0.73, and Perseverative errors: 0.74. Split-half reliability: 0.83 (completed categories) and 0.87 (perseverative errors). For discriminant validity, the WCST was administered to students with high and low anxiety levels. The results showed that the high-anxiety group scored higher in perseverative errors and total incorrect responses, whereas the low-anxiety group performed better on pattern completion and set maintenance (Shahgholian et al., 2012).

Intervention

The self-monitoring of attention educational program was designed based on the Hallahan & Hudson (2002) model (Hallahan & Hudson, 2002) and research by Bahadorikhosroshahi (2022) and Khalili Azar (2015) (Bahadorikhosroshahi et al., 2022; Khalili Azar, 2015). The program was implemented in 12 sessions, each lasting 30-45 minutes. The content validity and face validity of the program were assessed through expert reviews and consultations with an experienced first-grade teacher. The results confirmed that the program met the necessary validity requirements for implementation. Additionally, the Kappa coefficient was calculated to ensure greater precision in validity assessment (K = 0.57). It is important to note that the Kappa coefficient ranges from -1 to +1, where values closer to +1 indicate strong agreement, values near -1 indicate inverse agreement, and values near zero indicate no agreement.

Session 1: Introduction and Explanation of Attention

In this session, a friendly relationship was established with students. The concepts of paying attention and not paying attention were introduced to them.

Sessions 2 and 3: Explanation and Review of the Self-Monitoring Method, Introduction of Tools, and Task-Oriented vs. Non-Task-Oriented Activities

These sessions focused on introducing and reviewing the self-monitoring of the attention strategy. It was ensured that the students understood the method and were capable of implementing the strategy.

Sessions 4 to 7: Practice and Repetition of Self-Monitoring; Implementing the Self-Monitoring Attention Assessment During Tasks

In these sessions, students practiced self-monitoring strategies while completing validated academic tasks. Students were instructed to review their behavior every time they heard a beep sound and record their self-assessments in their observation tables.

Session 8: Removal of the Audio Tape

In this session, the audio tape with irregular beeping sounds was removed. Students were encouraged to continue their tasks independently without the assistance of auditory cues.

Session 9: Removal of the Marking Checklist

In this session, the marking checklist was also eliminated. Students practiced a self-monitoring program without any external aids. The instructor used an observation card to record students' attention levels.

Sessions 10 to 12: Practicing Self-Monitoring Without Tools

In the final sessions, students completed tasks without any tools, relying solely on their internalized self-monitoring strategies. The instructor continued to use an observation card to record students' attention levels and task-related activities.

Data Analysis

Data analysis was conducted using SPSS software (version 27). Based on the level of measurement and statistical assumptions, the following analyses were performed: descriptive statistics, including mean and standard deviation. Inferential statistics: Data analysis was performed using analysis of variance with repeated measures. The significance level was set at 0.05.

Findings and Results

The participants in this study were 30 female students with mathematical learning disabilities. The mean age and standard deviation for the experimental group were 7.42 ± 0.57 years, and for the control group, 7.44 ± 0.45 years. The results of the independent t-test showed that the groups were homogeneous in terms of age, and there was no statistically significant difference between them ($t = 0.067$, $p = 0.94$). Table 1 presents the descriptive statistics of the experimental and control groups for the research variables before and after the implementation of the self-monitoring attention educational program. As shown in Table 1, the mean scores of the experimental and control groups in all dependent variables were almost equal at the pre-test stage. However, after implementing the self-monitoring of attention educational program, the mean scores of the experimental group changed at the post-test and follow-up stages. The significance of these changes was examined using repeated-measures analysis of variance.

Table 1

Descriptive Statistics of Research Variables

Variables	Group	Pre-test		Post-test		Follow-up	
		M	SD	M	SD	M	SD
Concentration	Experimental	7.60	0.986	9.33	0.976	9.80	1.146
	Control	7.73	1.03	8.00	1.13	7.86	0.91
Error in persistence (cognitive flexibility)	Experimental	17.46	2.58	15.00	2.77	15.00	2.92
	Control	18.26	4.25	18.53	4.25	18.40	4.73
Number of completed floors (cognitive flexibility)	Experimental	1.33	0.97	2.267	0.88	2.20	1.01
	Control	1.40	0.98	1.40	0.82	1.60	0.82

Next, the assumptions of variance analysis, including homogeneity of variances, homogeneity of the variance-covariance matrix, and normality of data distribution, were examined. The normality of data was assessed using the Shapiro-Wilk test at the pre-test, post-test, and follow-up stages. The results confirmed that the variables were normally distributed in both the experimental and control groups ($p>0.05$). The homogeneity of variances was tested using Levene's test, which confirmed that this assumption was met for the dependent variables at the post-test stage ($p>0.05$). The assumption of the variance-covariance matrix homogeneity was examined using M Box's test, where the F-statistic was not significant for the dependent variables across groups ($F = 0.65$, $p= 0.5$). The sphericity assumption was violated for the concentration variable ($p = 0.002$). Therefore, the results were adjusted using the Greenhouse-Geisser correction for reporting within-group effects for this variable. The results of the analysis of variance with repeated measurements are shown in Table 2.

Table 2

Variance Analysis Results for Within-Group and Between-Group Differences

Variables	Source of Change	SS	df	MS	F	P	Partial η^2
Concentration	Time	24.544	1	24.54	8.60	0.011	0.38
	Group	23.88	1.77	13.45	34.20	0.000	0.71
	Time × Group	16.95	1.86	9.11	16.90	0.000	0.54
Error in persistence (cognitive flexibility)	Time	149.511	1	149.511	6.05	0.027	0.30
	Group	25.756	2	12.878	9.596	0.001	0.40
	Time × Group	35.622	2	17.811	19.913	0.000	0.58
Number of completed floors (cognitive flexibility)	Time	4.022	1.37	2.93	8.07	0.006	0.366
	Group	9.34	1	9.34	7.34	0.017	0.344
	Time × Group	5.75	1.17	4.90	6.40	0.018	0.314

The results of Table 2 indicate that the scores of the variables were significant both within groups and for the test × group interaction across the three measurement stages ($p < 0.05$). The between-group results showed that the mean differences for Concentration and cognitive flexibility were significant. The Bonferroni post hoc test was used for pairwise comparisons, as shown in Table 3.

Table 3

Bonferroni Post Hoc Test

Variables	Pairwise Comparison	Mean Difference	Standard Error	P-value
Concentration	Pre-Test – Post-Test	-1.733*	0.228	0.001
	Pre-Test – Follow-Up	-2.20*	0.341	0.001
	Post-Test – Follow-Up	-0.467	0.215	0.144
Error in persistence (cognitive flexibility)	Pre-Test – Post-Test	2.467*	0.256	0.001
	Pre-Test – Follow-Up	2.467*	0.322	0.001
	Post-Test – Follow-Up	0.001	0.218	1
Number of completed floors (cognitive flexibility)	Pre-Test – Post-Test	-0.933*	0.067	0.001

	Pre-Test – Follow-Up	-0.867*	0.236	0.008
	Post-Test – Follow-Up	0.067	0.248	1

Based on the results in Table 3, there were significant differences in attention and cognitive flexibility scores between the pre-test and post-test stages, as well as between the pre-test and follow-up stages. Additionally, it was found that the difference in mean scores between the post-test and follow-up stages was not significant ($p > 0.05$), indicating the sustained effect of the intervention. The comparison of means shows that both Concentration and cognitive flexibility significantly increased in the post-test and follow-up stages compared to the pre-test stage (For cognitive flexibility, lower scores in persistence errors indicate higher cognitive flexibility).

Discussion and Conclusion

This study aimed to investigate the effectiveness of the self-monitoring of attention educational program on Concentration and cognitive flexibility in elementary school students with specific learning disabilities. The study's findings indicated a significant effect of the self-monitoring of attention educational program on improving Concentration in students with specific learning disabilities. This finding aligns with previous research that has confirmed the positive impact of self-monitoring training on enhancing children's attention, Concentration, and accuracy (Melzer & Herwix, 2024; Noori et al., 2019; Tamm et al., 2013).

For example, in a study conducted on students with Down syndrome, the use of self-monitoring strategies led to a reduction in inattentiveness and an increase in accuracy and Concentration (Noori et al., 2019). The results of this study emphasize that self-monitoring training improves attention in students with mathematical learning disabilities. This can be explained by the fact that specific learning disabilities result from cognitive deficits, including difficulties in attention, memory, and slow processing speed. Despite significant effort, students with these deficits struggle with reading accuracy, slow reading speed, poor comprehension skills, imprecise written expression, difficulty in recalling numerical facts, and inaccurate mathematical reasoning (Stanford & Delage, 2020).

During self-monitoring attention training sessions, students are taught techniques that help them record and evaluate their behavior. Self-monitoring methods involve frequency counting, where students track behaviors such as task completion, positive responses, accuracy in work, positive classroom behaviors, or achieving goals. These counts may be recorded by marking symbols, making circles, or placing objects in a container, which can enhance counting accuracy, focus, and target behaviors. One of the self-monitoring strategies involves using an audio tape that plays musical tones at random intervals, along with a self-monitoring sheet. While working, students listen to the tape and, upon hearing a tone, they are trained to ask themselves: "Was I paying attention?" They then record their response by marking "Yes" or "No" on the monitoring sheet. After recording their response, the student resumes their task until the next tone. This self-managed intervention improves Concentration and focus during tasks for students with learning disabilities and/or behavioral difficulties (Hallahan & Hudson, 2002; Hallahan et al., 2019).

Overall, given the impact of self-monitoring strategies, it can be concluded that self-regulation of one's behavior and environment allows students to control and monitor their academic tasks and processes, ultimately enhancing their ability to focus on activities (Tamm et al., 2013). The logic of self-monitoring training is based on the idea that efficiency increases through repeated practice of specific cognitive operations. Theoretically, practice leads to adaptations in the anatomical neural networks involved in these processes (Tamm et al., 2013). Additionally, controlled trials that have examined the effectiveness of self-monitoring attention training have reported improvements in attentional components, such as sustained attention, executive function, and Concentration (Melzer & Herwix, 2024; Noori et al., 2019; Tamm et al., 2013). For example, studies on children with ADHD have demonstrated significant therapeutic effects on parental and clinician ratings of ADHD symptoms, as well as children's self-reports of their Concentration abilities following attention-focused training (Tamm et al., 2013). Another study found that self-monitoring interventions yielded promising results in students with a combination of learning and attention difficulties (Melzer & Herwix, 2024).

Another finding of this study indicated that the self-monitoring of the attention educational program led to improvements in cognitive flexibility scores among participants in the experimental group. This finding is consistent with research confirming the positive impact of self-monitoring training on enhancing cognitive flexibility and executive functioning (Dağgöl, 2023; Tamm et al., 2013). Cognitive flexibility has a significant effect on mathematical performance in children, as mathematical tasks often require switching between different aspects of a task or employing various arithmetic strategies (de Santana et al., 2022).

The improvement in mathematical performance among students with mathematical learning disabilities after self-monitoring of attention training can be attributed to the fact that self-monitoring helps students identify their strengths and weaknesses, recognize problematic behavioral patterns, and develop strategies for improving their performance (Dağgöl, 2023). Furthermore, the role of self-monitoring attention strategies becomes apparent when students engage in goal-directed behaviors aimed at improving their academic, behavioral, and social skills. This concept is explained by goal representation, where the link between self-monitoring and cognitive flexibility is emphasized. By defining specific goals and switching between them, students must activate working memory and retain relevant information. Frequent activation strengthens goal representations, leading to enhanced cognitive flexibility (Blaye & Chevalier, 2011). Theoretically, self-monitoring exercises increase activity in prefrontal brain regions associated with cognitive flexibility. In simple terms, continuous and consistent training in self-monitoring of attention enhances brain areas responsible for cognitive flexibility, such as the fronto-parietal network and the amygdala. During self-monitoring training, positive neural adaptations occur from pre-test to post-test, leading to improved performance in executive function tasks, including cognitive flexibility (Tamm et al., 2013).

One limitation of the present study is that the sample was limited to students with mathematical learning disabilities within a specific age range and geographical area, which may limit the generalizability of findings to other populations or broader contexts. Expanding the sample to include diverse populations across different age groups and cultural backgrounds would improve the generalizability of the findings. Due to the short follow-up period (three months), long-term effects of the intervention cannot be reliably obtained. Research data collection was limited to self-report instruments, which could be associated with bias and distortion in the responses of sample individuals. Overall, the findings of this study highlight self-monitoring of attention as a promising strategy for enhancing attention and cognitive flexibility. This approach could be used to address cognitive challenges—specifically focus and cognitive flexibility—in students with specific learning disabilities.

Overall, the results of the present study emphasize the importance of self-monitoring attention as a promising strategy for enhancing concentration and cognitive flexibility, and it can be utilized to address cognitive difficulties (specifically, concentration and cognitive flexibility) in students with specific learning disabilities.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study included the fact that participation was entirely optional. Additionally, this study was approved by the Ethics Committee of Arak University of Medical Sciences, with the ethics code IR.IAU.ARAK.REC.1403.108

Transparency of Data

By the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

This article is derived from the doctoral dissertation of the first author at Islamic Azad University, Arak Branch. The second author served as the supervising professor and corresponding author, and the third author was the consulting professor in this research.

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