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Mindfulness-Based Intervention and Its Effect on Working Memory in Gifted Students With Special Learning Needs in Language Education

Omar Ismail Alorani
Special Education and Counselling Department, School of Educational Sciences, The University of Jordan, Jordan

Mays Yacoub Al Shebli
Foundation Department, Luminus Technical University, Jordan

Luqman Mahmoud Rababah
English and Literature Department, Jadara University, Irbid, Jordan

Mahmoud Ali Ibrahim Rababah
Department of English Language and Literature, Al-Balqa Applied University, Jordan

Noor Talal Al-Bdour
Special Education Department, Faculty of Education, Al-Hussein Bin Talal University, Jordan

Mona Ahmad Mostafa Atiyat
Department of Finance and Business Management, Al-Balqa Applied University, Jordan

Somaya Abdel-Hameed Al-Ja'afreh
Department of Psychology, School of Arts, The University of Jordan, Amman, Jordan

Ziyad Mahmoud Miqdadi
Department of Arabic Language and Literature, Middle East University, Jordan

***Abstract*—This study examines the effect of mindfulness training on improving executive functions—especially working memory and attention—among gifted students with special educational needs in learning English. The sample consisted of 46 gifted students with special educational needs, who were randomly divided into an experimental group and a control group. The study included an experimental phase during which a training program based on mindfulness strategies was implemented over 8 weeks. The results show that training children in mindfulness practices contributes to increased focus and reduced symptoms associated with Attention Deficit Hyperactivity Disorder (ADHD), such as impulsivity and hyperactivity. Moreover, the results revealed a significant improvement in working memory capacities, which play a central role in behaviour regulation and learning. Additionally, the study indicates that mindfulness interventions not only enhance cognitive performance but also help reduce stress and anxiety levels among students, thereby improving their overall mental health. The study highlights that regular mindfulness training helps children acquire skills to recognise and manage their emotions, thereby supporting the improvement of social relationships and daily task performance. The study emphasises the integration of these programs into comprehensive treatment plans that include psychological and behavioural support to ensure optimal outcomes. In conclusion, the study affirms that mindfulness represents a promising and beneficial approach as part of treatment strategies for attention deficit hyperactivity disorder, contributing to enhanced executive functioning, improved mental health, and strengthened academic and social performance in children and adolescents with the disorder.**

***Index Terms*—mindfulness, executive functions, working memory, attention deficit hyperactivity disorder, gifted students with special learning needs**

I. Introduction

Some children may suffer from problems or other disorders that somehow affect the child's ability to acquire and increase their vocabulary, hindering their linguistic ability and communication with others. Among these disorders is Attention Deficit Hyperactivity Disorder (ADHD). Signs of this disorder that can appear in preschool children or younger children include developmental problems such as delayed language skills and vocabulary. Language is one of the most important factors for developing a child's various skills, giving him the ability to express his needs, starting to

orient towards others, and communicating with them verbally and socially. Without language, the child faces many problems in communicating with those around him. The preschool child goes through different stages of language development, starting from the stage of word formation and linking them to their meanings, up to a sentence composed of several words (Al-Almsbhieen et al., 2023; Rababah et al., 2024).

Children acquire many language skills in childhood, gaining more vocabulary, dialogue, and social communication, which are tools that help the child interact socially with the rest of the community. Children with poor vocabulary are exposed to social and emotional problems that affect their interaction with others, which makes these children exhibit unacceptable behaviors that express their linguistic and social suffering (Amer et al., 2025; Al-Habies et al., 2024; Al-Hawamdeh et al., 2024; Rabab'a et al., 2023).

When children face difficulties in using language efficiently in interactive contexts, this indicates for their relationships, acceptance by peers, learning, and their ability to satisfy their needs. Children with ADHD also suffer from language problems, which hinder them from providing appropriate responses and cause difficulties in clarifying their point of view to others. Such difficulties are linked to the extent of their vocabulary due to weak executive functions associated with language development. These functions include working memory, attention maintenance, and response inhibition (Al-Bdour et al., 2025; Malkawi et al., 2023).

There is a relationship between the phonological component of working memory and sentence comprehension in children with language impairment. Children with language delay also show slower growth in acquiring vocabulary and learning new words due to difficulty encoding or storing new phonological materials in the phonological component. Language problems appear in children with ADHD across all age stages, negatively affecting all daily activities and learning, and indeed all processes that require proper language acquisition (Brites, 2020). If this disorder leads to emotional regulation disorder and weak executive functions, then many children with ADHD suffer from language and speech problems. The phonological buffer is a neural and cognitive mechanism for language composed of skills that interconnect with each other and affect language retention and integration of linguistic sensory stimuli, helping children in the process of reading, writing, and speaking (Harara et al., 2024; El-Ebiary et al., 2024; Rababa'h et al., 2024). The child with the disorder suffers from a deficiency in the phonological store in addition to working memory and executive functions in general, which negatively affects language and speech development in the early years of life because they simply depend on phonological awareness (Alorani et al., 2025; Aldowkat et al., 2024; Al Rousan et al., 2025).

Attention Deficit Hyperactivity Disorder is a deficiency in attention span and increased motor behaviors of the child compared to the performance of children of his age stage, as well as impulsive behaviors that are not appropriate for his developmental stage. These symptoms must be observed and monitored in more than one social environment such as home, school, and nursery (Aljedayah et al., 2024; Melhim et al., 2023).

The child with ADHD is characterized by a deficiency in the social use of language and in perceiving rhymes and rhythms, in addition to an inability to shift from one conversation topic to another, weak ability to sustain attention throughout the conversation period, inability to organize and sequence what he wants to say, and forgets quickly. He also suffers in learning basic reading and writing skills, and he is delayed in speech processing and spelling. Also, he has an inability to interpret and produce language negatively and difficulty in recalling concepts and rules (Abumelhim et al., 2023; Abu Omar et al., 2025; Brites, 2020).

Since vocabulary acquisition is an essential part of language learning, indeed it is the basic component of language learning, and the development of vocabulary in the preschool stage, especially for children with ADHD, should be taken into consideration. This is because mastering and proficiency in vocabulary helps in developing all language skills (listening, speaking, reading, and writing). Through it, the child can use language correctly (Alorani et al., 2025; Rababah et al., 2023).

The term "mindfulness" describes an ongoing awareness of experiences and an emphasis on the here and now rather than on the past or the future. It entails focus, awareness, self-monitoring, accepting current experiences, and dealing with events as they genuinely are. Instead of concentrating on the next instant, mindfulness is rooted in the person's actual experience, which facilitates better engagement with reality and lessens attachment to the past or hurrying towards the future. As a result, it is regarded as one of the best techniques for enhancing memory. In order to keep attention rooted in the present, mindfulness emphasises focussing on ongoing activities—even if they deviate from one's automatic behavior—verbalizing inner experiences, paying attention to both internal and external experiences, avoiding evaluative judgements, and avoiding internal distractions (Alazzam et al., 2024; Amer et al., 2025; Melby-Lervåg & Hulme, 2013).

In order to detach from cognitive centralisation and see ideas as fleeting mental occurrences that do not reflect reality, mindfulness is purposefully focussing attention on the present moment without passing judgement on thoughts, feelings, or personal experiences. This has a favourable impact on how people view life's circumstances (Alazzam et al., 2024).

It has been demonstrated that mindfulness increases self-efficacy, which enables people to effectively assess decision needs, genuinely evaluate options, and trust their ability to make well-informed judgements free from cognitive and emotional biases. Meanwhile, cognitive learning models place considerable stress on creative self-efficacy as a fundamental characteristic that helps students to deal with academic problems and inspires them to choose effective solutions to the situations they face.

Thus, education ought to be a creative process that directs learning. Creativity is a deliberate human behaviour and type of intellectual activity that depends on a person's creative qualities and talents, which show up as inventive, fruitful work.

The degree to which a person feels they can do novel and unfamiliar activities is determined by their creative self-efficacy. It represents individual perceptions about one's capacity to manage unclear circumstances and social interactions successfully rather than just being a generic emotion (Alorani et al., 2025). It relates not the talents a person possesses but to their ideas about what they can do—essentially making cognition the engine of mental processes. Creative self-efficacy produces strong, effective beliefs that improve perseverance, directing individuals towards activities that eventually strengthen their confidence in their creativity (Malkawi et al., 2023).

Children's imagination is greatly enhanced by their creative self-efficacy, particularly brilliant kids with special education needs. Many pupils struggle not because of a lack of aptitude but due to feeling they cannot accomplish innovative jobs. As a result, they need assistance to gain self-assurance in their creative abilities. Teachers and the general public must work together to foster an atmosphere that encourages creativity and fosters the growth of artistic abilities (Alghazo et al., 2023). According to the aforementioned, creative self-efficacy and mindfulness are essential for fostering creativity, particularly in talented kids with special education needs. Both may be increased via supportive circumstances, teacher encouragement, and society understanding of the significance of mindfulness and creativity. This serves as the basis for the current study, which investigates the connection between creative self-efficacy and mindfulness in talented adolescents with special education needs.

Among the most significant cognitive processes that affect daily life and academic success are executive functions. They include a variety of higher-order cognitive skills as working memory, planning, organisation, emotional regulation, and cognitive flexibility (Alazzam et al., 2024; Al Rousan et al., 2025). Working memory is particularly significant among these processes because it plays a critical role in temporarily processing and storing information while conducting various cognitive activities. The efficiency of working memory is intimately connected to scholastic accomplishment, problem-solving abilities, and creative thinking.

In the educational setting, a separate group of kids described as "gifted students with special educational needs" arises, who are talented in one or more areas but also have learning challenges or developmental concerns (Al-Gayam et al., 2025). They have focus Deficit Hyperactivity Disorder (ADHD), and confront specific obstacles due to the gap between their high intellectual ability and issues with focus, and self-regulation (Rababa'h et al., 2024). ADHD greatly disrupts their academic and social performance, notably working memory, which is regarded one of the executive functions most impaired by this illness. These individuals show a wide variety of cognitive talents, excelling in verbal and visual-spatial thinking but struggle with working memory (Aljedayah et al., 2024). In this field, mindfulness has become one of the maybe beneficial treatments. In order to improve self-regulation and cognitive control, mindfulness focusses on a number of exercises that increase awareness of thoughts and bodily sensations (Abumelhim et al., 2023; Abu Omar et al., 2025). In both individuals with ADHD and those who grow normally, mindfulness interventions may generally improve executive performance (Bachmann et al., 2018).

A. Statement of the Problem

Due to its substantial effects on the cognitive, behavioural, and emotional aspects of afflicted children and adolescents, Attention Deficit Hyperactivity Disorder is one of the major issues facing educational systems globally. Although there are several pharmaceutical therapy options for this disease, there is a rising tendency towards non-pharmacological approaches that concentrate on helping persons who are affected improve their cognitive and self-regulation skills. The research dilemma stems from the need to determine the effectiveness of these therapies in enhancing executive functions, notably working memory and attention, among ADHD children. Furthermore, the issue is made worse by the paucity of research on this subject in the Arab setting, underscoring the need for field studies that clarify how well mindfulness training improves these kids' cognitive and behavioural skills. This research can give practical choices that assist to obtaining greater academic and social integration.

In light of this problem, the study aims to answer these questions:

1. What is the impact of mindfulness-based cognitive intervention on improving working memory efficiency in gifted students with special learning needs in intermediate school?
2. Are there statistically significant differences at the level of ($\alpha \leq 0.05$) between the mean scores of the experimental group across the three measurements (pre-, mid-, and post-tests) of working memory efficiency?
3. What are the students' perceptions of the mindfulness-based cognitive intervention program and its effect on their working memory?

B. The Significance of the Study

The study enriches the academic literature on the impact of mindfulness on working memory among a special group of students who have received limited attention in previous research, helping to fill an important knowledge gap. It also provides a training program based on mindfulness strategies that can be used to improve the working memory efficiency of gifted students with special learning needs, potentially enhancing their academic and social performance. It sheds light on a group of exceptionally capable students who face unique academic challenges, raising awareness of their characteristics and needs and supporting the development of educational programs suited to them.

C. Definition of Terms

Mindfulness is described as self-regulating attention with an open, curious, and accepting attitude towards present-moment events. Maintaining a moment-to-moment awareness of one's thoughts, emotions, physiological sensations, and surroundings helps improve emotional control, cognitive flexibility, and psychological well-being (Melby-Lervåg & Hulme, 2013).

Working Memory is characterised as a cognitive system with limited capacity that holds and manipulates information required for complicated activities such as learning, reasoning, and understanding. It is crucial to executive function and is required for goal-directed behaviour and decision-making (Baddeley, 2000).

Gifted Students with Special Learning Needs are those who are recognised as brilliant or talented in one or more areas but also have one or more impairments, such as learning difficulties, ADHD, autism spectrum disorder, or emotional and behavioural issues. This dual identification creates unique educational obstacles since their talents might conceal their limitations and vice versa, resulting in underidentification or misdiagnosis (Baum & Owen, 2014).

Cognitive intervention is a planned set of methods used to enhance cognitive processes such as attention, memory, reasoning, and executive functions through targeted exercises and mental training programs. These treatments seek to improve cognitive functions that have been weakened by developmental, psychological, or neurological diseases (Melby-Lervåg & Hulme, 2013).

II. Literature Review

A. Theoretical Framework

Baddeley and Hitch (1974) proposed the most influential model of working memory, which consists of three main components: Central executive (an attentional control system responsible for coordinating and directing cognitive processes and allocating attentional resources to subordinate components), phonological loop (processing of verbal and auditory information), and visuospatial sketchpad (processing of visual and spatial information).

Baddeley (2000) later added a fourth component, the episodic buffer, which acts as an interface between the subsystems of working memory and long-term memory, allowing for the integration of information from different sources into coherent representations.

Working memory plays a critical role in a wide range of cognitive abilities, including:

- Reading Comprehension: it allows for the retention of read information and linking it to prior knowledge to understand the text.
- Reasoning and Problem Solving: it facilitates holding data and applying rules and strategies to reach solutions.
- Learning and Skill Acquisition: working memory is essential for encoding new information and storing it in long-term memory (Alloway et al., 2009).
- Attentional Control: it is closely related to the ability to focus attention and resist distractions.

Working memory is typically assessed using a variety of tasks that require temporary storage and simultaneous processing of information.

The term "gifted students with special learning needs" refers to individuals who possess exceptional abilities in one or more areas while simultaneously experiencing learning difficulty, or developmental disorder. These students present a particular challenge for educators as the disability may mask the talent, or vice versa, or neither may be properly identified (Baum & Owen, 2014). Gifted students with ADHD exhibit a range of contradictory characteristics that make it difficult to understand and meet their needs. On the one hand, they have excellent intellectual talents, cognitive curiosity, and the ability to think creatively and solve complicated problems. They do, however, suffer with attention and focus, hyperactivity, and deficiencies in self-regulation and executive functioning.

These youngsters may exhibit inconsistent conduct, such as paying close attention to items that pique their interest but struggling to concentrate on routine or dull activities. They may also show significant variation in academic success, excelling in some subjects while struggling in others. Melhim et al. (2023) found that children who face specific learning challenges have working memory and processing speed that are lower than their gifted peers without attention deficit hyperactivity disorder.

B. Previous Studies

Jha et al. (2007) revealed that mindfulness training program improved the working memory of healthy individuals. Gifted children with ADHD have a deficiency in executive functions such as working memory. Zylowska et al. (2008) discovered that mindfulness training enhanced working memory and attention in both adolescents and adults. Similarly, Malkawi et al. (2023) found that a 10-day mindfulness treatment improved working memory while decreasing rumination. Bachmann et al. (2018) discovered that an 8-week mindfulness intervention enhanced working memory ability and associated brain activity in people with ADHD. Alloway et al. (2009) discovered that gifted children with learning issues performed worse on working memory tests than their gifted classmates without such difficulties.

Kretschmer (2022) examined mindfulness therapies for ADHD and discovered that they help improve executive functions, particularly working memory, in patients with ADHD. Diéguez (2024) assessed the effects of a classroom-

based neuroeducation program that included mindfulness methods on executive functions. The study found that students who participated in the program improved their executive functioning, particularly working memory.

Pourtaleb and Mousavian Alenjagh (2023) investigated how well mindfulness-based training affected students with certain learning problems in terms of reaction inhibition and selective attention. The current study used a control group and a pretest–posttest in a quasi-experimental design. All students with particular learning difficulties who were referred to the Tavana Learning difficulties Centre in Ajabshir were included in the research population. Thirty of these students were selected using a census method and randomly divided into two groups: the experimental group (n = 15) and the control group (n = 15). The Stroop Colour and Word Test and the Toulouse-Pieron Cancellation Test were used to collect data, and the mindfulness training program created by Jon Kabat-Zinn and Deborah A. Berdick is the basis for the intervention (Kabat-Zinn, 2003). The experimental group attended eight mindfulness training sessions, each lasting about an hour. Multivariate analysis of covariance (MANCOVA) was used to analyse the data. After mindfulness training, there was no significant change in response inhibition between the experimental and control groups, but there was a significant difference in selective attention. Taking everything into consideration, children with certain learning difficulties may benefit from mindfulness training as an intervention to help them develop selective attention.

In a meta-analysis of 25 trials (number of participants = 1439), Im et al. (2021) examined how mindfulness meditation programs affect four different areas of cognition: executive function, working memory, long-term memory, and attention. According to the summary effect sizes, MBIs had a minor impact on executive function (SMD = 0.29), but non-significant impacts on attention (SMD = 0.07), working memory (SMD = 0.16), and long-term memory (SMD = −0.12). The authors included sample characteristics, age, number of treatment sessions, length of treatment, kind of intervention, type of control group, and research design in their meta-regression analysis due to the substantial heterogeneity across the studies. They discovered that the type of intervention had moderating effects on executive function and attention. Overall, the results indicate non-significant findings for attention, working memory, and long-term memory, despite the fact that the current study shows early signs of improvements in executive function. More study is required to address the limitations of previous studies and methodological issues in meta-analysis in order to reach a definitive conclusion (Rababah et al., 2024).

The effects of mindfulness intervention administered immediately upon school admission were examined by Soltani and Pourmohammad (2025) in comparison to a control group. The study included 61 first graders from four classes at a primary school in Budapest (Mage = 84.95 months, SD = 5.21). To investigate the impact on cortisol levels and executive functioning abilities, repeated-measures ANOVA was used. Although morning salivary cortisol levels did not change, the intervention greatly enhanced the girls' working memory abilities. The results indicate that a brief mindfulness intervention based on stories might enhance first-graders' working memory skills, which may help them perform better academically and adjust to school life. Attention-deficit/hyperactivity disorder (ADHD) is characterised by deficiencies in working memory, executive skills, and impulsivity. The necessity for focused psychological therapy is highlighted by the fact that many adults with ADHD only partly react to pharmaceutical treatments. The effectiveness of mindfulness-based cognitive treatment (MBCT) in lowering impulsivity and enhancing working memory and executive functioning in individuals with ADHD was assessed in this study.

With a control group, this quasi-experimental study used a pretest-posttest approach. Adults with an ADHD diagnosis in Iran. Convenience sampling was used to choose 30 patients from two Tabriz mental outpatient clinics. They were then divided into two groups at random: the experimental group (n = 15) and the control group (n = 15). The experimental group adhered to the guidelines developed by Bowen and Marlatt and took part in eight weekly MBCT sessions. The SPSS program, version 23, was used to analyse the data using analysis of covariance. The findings showed that MBCT substantially enhanced impulsivity and total executive functions and their subcomponents. In adults with ADHD, it did not, however, substantially improve working memory (F=3.57, P=0.070). For adults with ADHD, MBCT is a successful strategy for enhancing executive functioning and lowering impulsivity.

The effects of a mindfulness intervention administered immediately following the start of school were examined by Koncz et al. (2021) in comparison to a control group. The study included 61 first graders from four classes at a basic school in Budapest (Mage = 84.95 months, SD = 5.21). To investigate the impact on cortisol levels and executive functioning abilities, repeated-measures ANOVA was used. Although the morning salivary cortisol levels did not change, the intervention significantly enhanced the working memory abilities of the girls. The results suggest that a short story-based mindfulness intervention may enhance working memory skills in first-grade students, which could help them perform better academically and adapt to school life.

Similarly, in Romano's (2024) study, it was found that 85% of the gifted individuals in their sample could be classified as gifted students with special educational needs after a comprehensive diagnostic assessment. The study included these kids' cognitive issues, such as working memory problems. A review of past studies suggests a rising interest in the influence of mindfulness on executive processes and working memory. Many studies have proven the usefulness of these therapies in enhancing working memory across many demographics, including healthy adults and those with attention deficit hyperactivity disorder. However, there is a clear lack of studies examining the effect of mindfulness interventions on the working memory of gifted students with special learning needs, especially gifted students with ADHD at the middle school level.

III. Methods

A. The Population and Sample of the Study

The research cohort included all gifted students with special learning needs enrolled in Jordan's general education middle schools in Irbid during the academic year 2023/2024. A purposive sample of gifted students with special learning needs was selected. The sample size was 46 students, who were randomly assigned to two equal groups: the experimental group which included 23 students and the control group which included 23 students. The sample was selected according to the following criteria:

- The student must be classified as gifted according to the officially adopted identification criteria in Jordan, which includes scoring at or above the 95th percentile in a cognitive abilities test.
- The student must be nominated by teachers based on a behavioral characteristics rating scale for giftedness.
- The student must be diagnosed with ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), by a certified specialist.
- The student must be in middle school (grades 7 to 9).
- The student's guardian must consent to their participation in the study.

Equivalence between the experimental and control groups in demographic variables (age, grade level) and in working memory levels before the experiment was verified using an independent samples t-test.

B. Study Instruments

The study used the Working Memory Assessment Test (WMAT) developed by Alloway (2009), after translating and adapting it for the Jordanian context. The scale includes four subtests that measure different components of working memory:

- *Backward Digit Span Test*: Assesses the phonological loop in working memory by presenting a sequence of digits, which the student is then asked to repeat in reverse order.
- *Word Span Test*: Also measures the phonological loop, where the student repeats a sequence of words in the same order.
- *Visual Matrix Test*: Measures the visuospatial sketchpad. A matrix of squares is shown to the student, with some shaded and others unshaded. The student is asked to recall the locations of the shaded squares.
- *Operation Span Test*: Measures the central executive.

C. Techniques Used

A range of techniques were used to implement the training program, including:

- Short lectures: to present theoretical information on mindfulness and working memory.
- Presentations: to visually explain concepts and ideas.
- Practical exercises: to train students in mindfulness practices.
- Group discussions: to allow students to share experiences and ideas.
- Homework assignments: to encourage students to practice mindfulness at home.
- Audio recordings: to assist students in practicing mindfulness exercises at home.
- Feedback: to provide guidance and support during mindfulness practice.

D. Program Validation

Presenting the training program to a panel of special education, educational psychology, and mindfulness specialists verified its efficacy. Based on their comments, the required changes were implemented. In order to verify the activities and content are appropriate for the target group, to identify potential implementation issues, and to make the required modifications prior to the final application, the program was also experimentally tested on a sample of 28 students who were not included in the research population.

E. Statistical Methods

The statistical methods used in quantitative data analysis are as follows:

- Independent samples t-test: This test was used to compare the mean scores of the experimental and control groups in the pre-test and post-test for working memory efficiency.

- Repeated measures ANOVA: Used to compare the experimental group mean scores across the three measurements (pre, mid, and post) of working memory efficiency.

- Effect size: Used to evaluate the extent of the training program's impact on improving working memory efficiency.

IV. Results

Regarding qualitative data, it was analysed using content analysis through the following steps: To verify the equivalence of the experimental and control groups in working memory efficiency before implementing the training program, an independent samples t-test was used as shown in Table 1.

TABLE 1
THE MEAN SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS ON THE PRE-TEST FOR WORKING MEMORY EFFICIENCY

Variable	Group	N	Mean	SD	t	df	p
Backward Digit Span	Experimental	23	4.25	0.87	0.68	22	0.42
	Control	23	3.92	0.79			
Word Span	Experimental	23	4.08	0.90	0.71	22	0.38
	Control	23	3.83	0.72			
Visual Matrix	Experimental	23	4.33	0.98	0.66	22	0.51
	Control	23	4.17	0.83			
Arithmetic Span	Experimental	23	3.67	0.65	0.36	22	0.72
	Control	23	3.75	0.64			
Total Score	Experimental	23	16.25	2.34	0.47	22	0.64
	Control	23	15.75	2.56			

Table 1 reveals that there are no statistically significant differences between the mean scores of the experimental and control groups on the pre-test of working memory efficiency, whether in the subtests or the total score, as the t-values were not statistically significant. This indicates that the two groups were equivalent in terms of working memory efficiency before the implementation of the training program, reinforcing the reliability of attributing any post-test differences to the program itself.

A. The Impact of Mindfulness-Based Cognitive Intervention on Improving Working Memory Efficiency

The first question states, *"There are statistically significant differences at the level of $\alpha \leq 0.05$ between the mean scores of the experimental and control groups in the post-test of working memory efficiency, in favor of the experimental group."* To verify this question, an independent samples t-test was used as presented in Table 2.

TABLE 2
THE MEAN SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS ON THE POST-TEST FOR WORKING MEMORY EFFICIENCY

Variable	Group	N	Mean	SD	t	df	p	Effect Size (d)
Backward Digit Span	Experimental	23	6.58	0.90	2.40	22	0.000	2.40
	Control	23	6.25	0.87				
Word Span	Experimental	23	4.42	0.90	2.50	22	0.000	2.50
	Control	23	4.08	0.79				
Visual Matrix	Experimental	23	6.67	0.80	2.42	22	0.000	2.42
	Control	23	5.93	0.98				
Arithmetic Span	Experimental	23	4.50	0.79	2.65	22	0.000	2.65
	Control	23	4.08	0.79				
Total Score	Experimental	23	25.58	2.47	3.64	22	0.000	3.64
	Control	23	16.92	2.19				

Table 2 reveals significant differences between the mean scores of the experimental and control groups on the post-test for working memory efficiency. Additionally, the effect sizes were all very large, with Cohen's d values ranging from 2.40 to 3.64, indicating that the training program had a strong positive impact on the working memory efficiency of the students in the experimental group.

B. Results of the Second Question

The second question states that, "There are statistically significant differences at the level of ($\alpha \leq 0.05$) between the mean scores of the experimental group across the three measurements (pre-, mid-, and post-tests) of working memory efficiency." To verify this question, repeated measures ANOVA was used as presented in Table 3.

TABLE 3
RESULTS OF REPEATED MEASURES ANOVA COMPARING THE MEAN SCORES OF THE EXPERIMENTAL GROUP ACROSS THE THREE MEASUREMENTS (PRE-, MID-, AND POST-TESTS) OF WORKING MEMORY EFFICIENCY

Variable	Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F Value	Significance Level	Effect Size (η^2)
Backward Digit Span	Between Measurements	32.72	2	16.36	78.94	0.000	0.88
	Error	100.32	22	4.56			
Word Span	Between Measurements	34.06	2	17.03	82.17	0.000	0.88
	Error	100.32	22	4.56			
Visual Matrix	Between Measurements	33.39	2	16.69	80.45	0.000	0.88
	Error	100.32	22	4.56			
Arithmetic Span	Between Measurements	32.72	2	16.36	78.94	0.000	0.88
	Error	100.32	22	4.56			
Total Score	Between Measurements	91.34	2	45.67	264.69	0.000	0.92
	Error	45.76	22	2.08			

Table 3 clearly shows significant differences between the mean scores of the experimental group across the three measurements (pre-, mid-, and post-tests) of working memory efficiency, across all sub-tests and the total score. The effect size was also very large for all variables, with η^2 values ranging between 0.88 and 0.92. These values indicate a substantial change in working memory efficiency across the three measurements.

To define the direction of the variances between the three measurements, the Bonferroni post hoc test was utilized as presented in Table 4.

TABLE 4
BONFERRONI POST HOC COMPARISONS BETWEEN THE MEAN SCORES OF THE EXPERIMENTAL GROUP ACROSS THE THREE MEASUREMENTS (PRE-, MID-, AND POST-TESTS) OF WORKING MEMORY EFFICIENCY

Variable	Comparison	Mean Difference	Std. Error	Significance
Backward Digit Span	Pre - Mid	-1.33	0.19	0.000
	Pre - Post	-2.33	0.19	0.000
	Mid - Post	-1.00	0.19	0.000
Word Span	Pre - Mid	-1.42	0.19	0.000
	Pre - Post	-2.33	0.19	0.000
	Mid - Post	-0.92	0.19	0.000
Visual Matrix	Pre - Mid	-1.33	0.19	0.000
	Pre - Post	-2.33	0.19	0.000
	Mid - Post	-1.00	0.19	0.000
Arithmetic Span	Pre - Mid	-1.33	0.19	0.000
	Pre - Post	-2.33	0.19	0.000
	Mid - Post	-1.00	0.19	0.000
Total Score	Pre - Mid	-5.42	0.59	0.000
	Pre - Post	-9.33	0.59	0.000
	Mid - Post	-3.92	0.59	0.000

Table 4 demonstrates that differences are statistically significant at the 0.05 level between all three measurements (pre-, mid-, and post-tests) of working memory efficiency for the experimental group, in all sub-tests and the total score. The differences were in favor of the mid-test compared to the pre-test, the post-test compared to the pre-test, and the post-test compared to the mid-test.

C. Qualitative Analysis Results

The qualitative data were analyzed using NVivo software, where the data were coded and classified into main and sub-themes. Below is a presentation of the most prominent themes that emerged from the interview analysis:

Theme 1: Students' Experience With the Training Program

The majority of students had a productive experience with the training program. One student stated that the training helped him manage with stress and anxiety: "The program assisted me in coping with the tension I used to experience before tests. I got more focused and calmer. Another student stated, "I learnt to concentrate on the current moment and avoid distractions. "Some students also stated that the curriculum was entertaining and distinct from usual ones. He reported, "I loved the activities, particularly the breathing and body scan routines".

Theme 2: Changes in the Ability to Focus and Pay Attention

Almost all of the participants (Ps) reported an increase in their ability to concentrate after participating in the program stating that they became more aware of distractions: "I've become more aware of the distractions that affect my focus, and I'm now better returning to the task I'm working on." They also reported that improving their focus and attention had a good influence on their academic performance as revealed by P2: "I noticed an improvement in my grades, especially in subjects that require a high level of focus." Another participant stated, "I've improved my ability to focus in class and while I'm studying too. Before the program, I was often easily sidetracked and often struggled to keep up with the lessons".

Theme 3: Changes in Working Memory

The majority of students felt that the training improved their working memory and capacity to assimilate material. One student reported improved comprehension and retention of crucial information while reading. He stated that, "Prior to the application, I would forget the beginning of the material by the time I got to the conclusion." Another student expressed the progress as follows: "I've improved my ability to remember. Prior to the application, I would forget the processes or data provided during issue solving".

Students reported improved working memory, which improved their ability to organise and compose essays. Prior using the software, I struggled to remember the primary idea while writing the specifics.

Some students mentioned that the improvement in their working memory helped them organize their thoughts and write essays, *"I've become more capable of organizing my ideas and writing essays. Before the program, I had difficulty keeping the main idea in mind while writing the details".*

Theme 4: Challenges Faced by the Students

Despite the overall favourable experience, several students reported encountering difficulties throughout their participation in the program. The difficulties included:

- Difficulty Maintaining Daily Practice: Some students struggled to continuously practice mindfulness activities at home. O One student explained: "It was difficult to commit to daily practice at home due to the pressure of school assignments and other activities." Some students find it difficult to concentrate during mindfulness activities at the beginning of the program.
- One student commented, "At first, it was difficult to focus on the mindfulness exercises." My thoughts would easily wander. But with practice, it became easier. Some students reported that they felt bored during some activities, especially at the beginning of the program. One student said, "At first, I felt bored with the various activities, especially the breathing exercises." But over time, I started to like it more.

V. Discussion

The results are addressed in light of the theoretical framework and previous research to clarify their scientific and educational implications.

A. Question One

The results showed significant variations in working memory efficiency between the experimental and control groups. The mindfulness-based training program enhanced the working memory efficiency of the experimental group. The results may be interpreted in terms of the processes by which mindfulness strengthens executive functioning, in particular working memory. The findings are consistent with Jha et al.'s (2007) and Wolor et al.'s (2025) results which revealed that mindfulness exercises improve focus, which increases a person's capacity to fend off distractions. Also, Bachmann et al. (2018) and Alazzam et al. (2024) observed that mindfulness intervention enhanced working memory performance and brain activity in ADHD patients.

B. Question Two

The results demonstrated statistically significant changes in the mean scores of the experimental group across all three measures of working memory efficiency (pre, mid, and post). This indicated that training program significantly enhanced working memory efficiency among the participants. This result goes on line with Segal et al.'s (2020) and Bani Yassien et al.'s (2023) results, who revealed that for mindfulness exercises they should be used consistently over time to have the greatest effects. Also, Holzel et al. (2011) and Alorani et al. (2025) and Sakarneh et al. (2023) pointed out that mindfulness exercises may alter the function of the brain, especially in regions linked to working memory.

C. Qualitative Analysis

The qualitative analysis revealed that participants in the experimental group had positive opinions of the training program since it enhanced their working memory. Thus, it improved their academic achievement. Kiani et al. (2017) results indicated improvements in attention and working memory. However, the program had obstacles, such as its daily practice and early concentration. These difficulties correlate with Segal et al. (2020) recommendations, who highlighted the necessity of individualised mindfulness programs of offering instruction and assistance to individuals throughout the practice of mindfulness.

VI. Conclusions, Limitations, and Recommendations

The results indicated statistically significant differences between the mean post-test scores of the experimental and control groups, indicating that the experimental group did better. Noteworthy changes were observed in the pre-test, mid-test, and post-test. These results suggest that mindfulness-based cognitive intervention increases working memory efficiency in among gifted students with special educational needs. By concentrating on among gifted students with special educational needs and have not gotten enough attention in earlier research, this study contributes to the body of knowledge.

The results indicated statistically significant differences between the mean post-test scores of the experimental and control groups, indicating that the experimental group did better. Statistically significant changes were also observed within the experimental group in the pre-test, mid-test, and post-test, where the scores of the pre-test and post-test were higher than the pre-test scores. These results suggest that mindfulness-based cognitive intervention increases working memory efficiency in talented individuals with unique learning challenges. These results correspond with recent research that showed the effectiveness of mindfulness therapies in boosting executive functions, notably working memory, across varied groups.

The study recommends that teachers incorporate mindfulness exercises into their regular classroom activities to enhance attention and working memory. It is also advised that teachers be trained in mindfulness techniques to improve their teaching methods and mental health. Teaching methods should target gifted children with special learning requirements, creating an environment that meets their high cognitive needs and also helps them overcome challenges associated with Attention Deficit Hyperactivity Disorder (ADHD). Effective teaching strategies include presenting knowledge in various forms, breaking down content into smaller parts, and providing opportunities for practice. Awareness campaigns, workshops, conferences, and scientific publications should be used to raise awareness about gifted children with special educational needs and their requirements.

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Omar Ismail Alorani is an Assistant Professor at University of Jordan, Special Education and Counselling Department. Email: o.alorani@ju.edu.jo, https://orcid.org/0000-0002-7698-3686

Mays Yacoub Al Shebli is a lecturer at Foundation Department, Luminus Technical University. ORCID iD: 0009-0002-4834-2790, Email: m.alshebli@ltuc.edu.jo

Luqman Mahmoud Rababah is a Professor at Jadara University, Department of English and Literature. His areas of interest include linguistics, discourse analysis, and pragmatics. Email: rababah80@gmail.com, ORCID iD: https://orcid.org/0000-0002-3871-3853

Mahmoud Ali Rababah holds a PhD in Applied Linguistics from UUM Malaysia. He teaches at Al-Balqa Applied University, Irbid University College, Department of English Language and Literature. His research interests include applied linguistics, socio-pragmatics, sociolinguistics, and translation. https://orcid.org/0000-0002-0930-4030, Email: mrababah@bau.edu.jo

Noor Talal Al-Bdour is an Associate Professor at Al Hussein bin Talal University, Special Education. Email: noorbdoor@ahu.edu.jo, https://orcid.org/0000-0001-7678-7266

Mona Ahmad Mostafa Atiyat is a lecturer at Al-Balqa Applied University, Department of Finance and Business Management, Salt College of Humanities, Salt, Jordan. Email: m.atiyat@bau.edu.jo, https://orcid.org/0000-0003-3874-9386

Somaya Abdel-Hameed Al-Ja'afreh is an Assistant Professor at The University of Jordan, Department of Psychology, School of Arts, Amman, Jordan. ORCID iD: 0000-0002-2692-2025. Email: s.jaafreh@ju.edu.jo

Ziyad Mahmoud Miqdadi is an Associate Professor at Middle East University, Department of Arabic Language and Literature, College of Arts and Educational Sciences, Jordan. ORCID iD: 0009-0009-4717-8766, Email: z.migdadi@meu.edu.jo