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Impact of mindfulness-based strategy training on working memory in twice-exceptional students in Saudi Arabia

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Abstract. *Introduction*. One of the most challenging tasks for a teacher is addressing the needs of students with twice-exceptionality, whose conflicting characteristics complicate the learning process. Implementing new strategies to foster a positive emotional environment and mitigate negative experiences for this group of students represents a promising approach that can enhance existing methods of positive psychology. *Aim.* This research *aims* to investigate the impact of mindfulness-based cognitive interventions on the efficiency of working memory in twice-exceptional Saudi middle school students. *Methodology and research methods.* The study involved the development of mindfulness strategies among the participants, followed by in-depth interviews to evaluate their perceptions of the results obtained. Measurements were conducted at three stages: prior to the intervention, midway through, and after its completion. To assess changes in verbal working memory, the Digit Span test was utilised, while the Corsi Block-Tapping Test was employed to evaluate visuospatial working memory. *Results.* Statistically significant differences ($p < 0.05$) were observed between the experimental and control groups at all stages of testing, indicating the effectiveness of the employed methods. This finding was further corroborated by the results of a qualitative analysis conducted using NVivo software. *Scientific novelty.* For the first time, this study investigates the impact of mindfulness strategies on the cognitive functions and emotional well-being of a lesser-studied group of students, who often remain outside the scope of traditional pedagogical research. *Practical significance.* The results can be utilised to develop specialised programmes for gifted students with twice-exceptionalities. Recommendations are provided for training teachers in methods that adopt a deliberate approach to instructing this group of students.

Keywords: mindfulness, working memory, twice-exceptional students, Saudi Arabia, middle schools

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Влияние тренинга по формированию осознанности на рабочую память учащихся с двойной исключительностью в Саудовской Аравии

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Аннотация. *Введение.* Одной из самых сложных задач для учителя являются ученики с двойной исключительностью (twice-exceptionality), чьи противоречивые характеристики затрудняют процесс обучения. Использование новых методов формирования позитивного эмоционального фона и снижения негативных переживаний у данной категории обучающихся представляет собой перспективное направление, способное дополнить существующие методы позитивной психологии. *Цель* – исследовать влияние когнитивного вмешательства, направленного на формирование осознанности, на повышение эффективности рабочей памяти у саудовских учениц средней школы с двойной исключительностью. *Методология, методы и методики.* Исследование включало формирование стратегий осознанности у участниц эксперимента с последующим проведением глубинных интервью для оценки восприятия полученных результатов. Измерения проводились на трех этапах: до вмешательства, в середине и после его завершения. Для оценки изменения вербальной рабочей памяти использовался тест «Цифровой диапазон» (Digit Span), для оценки зрительно-пространственной рабочей памяти – тест «Пространственная доска» (Corsi Block-Tapping Test). *Результаты.* Обнаружены статистически значимые различия ($p < 0,05$) между экспериментальной и контрольной группами на всех этапах тестирования, что свидетельствует об эффективности используемых методов и в дальнейшем было подтверждено результатами качественного анализа с использованием программного продукта NVivo. *Научная новизна*. Впервые исследовано влияние стратегий осознанности на когнитивные функции и эмоциональное состояние малоизученной группы обучающихся, часто остающихся за рамками традиционных педагогических исследований. *Практическая значимость*. Результаты могут быть использованы для разработки специализированных программ для одаренных учащихся, обладающих двойной исключительностью. Даны рекомендации по обучению педагогов методам осознанного подхода к обучению данной категории учащихся.

Ключевые слова: осознанность, рабочая память, ученики с двойной исключительностью, средняя школа, Саудовская Аравия

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Introduction

Mindfulness training is a cognitive approach that aims to improve an individual's ability to cope with stress, reduce mental strain, and enhance well-being and self-regulation. It focuses on observing and perceiving the immediate conscious

experience by non-judgmentally attending to internal and external stimuli and improving attentional control. Mindfulness training can complement tools inspired by positive psychology, which focuses on flourishing, promoting human growth, developing a positive attitude, and reducing negative emotions [1, 2].

For students to learn effectively in the classroom, they must be able to focus their attention, perceive multiple perspectives, recognise the novelty of current information, perceive the context of the information, and better understand it by creating new categories. Mindfulness training can help students mitigate the negative effects of environmental stress by focusing their attention on the present moment, enabling them to concentrate fully on classroom activities, making teaching and learning more effective [3, 4].

Mindfulness-based cognitive intervention focuses on participants' awareness of their relationship with their thoughts and feelings. It may include guided body scans, sitting and walking meditation, mindful movement (based on yoga), three-minute breathing exercises, and focused awareness during routine daily activities. Studies have shown that mindfulness-based interventions are associated with numerous positive outcomes in emotional regulation, including reduced anxiety, depression, and anger. Mindfulness can also enhance cognitive functioning at both basic and higher thinking levels [5, 6].

Mindfulness training offers children with Attention Deficit Hyperactivity Disorder (ADHD) an opportunity to observe internal and external stimuli without reacting impulsively, thereby reducing symptoms of hyperactivity, impulsivity, and loss of motivation. Mindfulness-based stress reduction (MBSR) strategies allow for changes in gray matter concentration in specific brain areas related to learning, memory, emotion regulation initiation, and processing of self-relevant external information. By comparing tests conducted before and after six 150-minute mindfulness training sessions and one approximately 400-minute session over eight weeks, significant increases in gray matter were found in areas such as the posterior cingulate gyrus (PCG), the 8th lobule of the cerebellum (8-L), the 1-2 lobules of the cerebellum, and the temporoparietal junction (TPJ) [7, 8, 9].

Mindfulness enhances an individual's functional performance in various daily interactions by improving insight, helping them recognise and interact with different activities moment by moment, developing problem-solving and decision-making skills, broadening their horizons, increasing openness to others, fostering flexibility in handling new opportunities, information, and ideas within the educational environment, and minimising routine and cognitive rigidity. The importance of mindfulness lies in its multiple competencies and capabilities, as well as its major role in developing individuals' awareness [10, 11, 12].

Mindfulness is a powerful tool that can improve cognitive skills, such as working memory, and can also aid individuals with memory impairments, such as elderly people with dementia [13]. It enhances individuals' sense of life meaning, coherence, and openness to new experiences, while also improving their ability to manage their surroundings by promoting qualitative stress-coping responses. Mental

mindfulness training has been shown to have positive effects on working memory, attention, emotional variables, self-esteem, and social behaviour among adolescents with intellectual and developmental disabilities. Even short-term mindfulness training can improve individuals' working memory. In an experiment conducted by N. W. Bailey, Freedman G., Raj K. et al. [9], the researchers recorded electroencephalography (EEG) from 29 individuals who had not undergone mindfulness training and 29 individuals who had received such training while performing a working memory task. The results showed greater accuracy in WM tasks compared to the control group, faster response times in the left temporal region of the brain, and a more frontal distribution of activity, suggesting a positive effect of mindfulness practice on improving individuals' working memory.

Mindfulness also affects verbal learning and memory, specifically encoding, consolidation, and retrieval processes in verbal learning and memory tasks. Encoding enhances the relationship between mindfulness and improved verbal memory, making mindfulness an effective intervention for tasks requiring the retention of new information. Mindfulness in educating gifted students can assist in addressing challenges they face due to the asynchronous development of their abilities, particularly focusing on areas of self-regulation and openness to new experiences, defined through self-exploration [14].

Mindfulness is effective for individuals with Attention Deficit Hyperactivity Disorder (ADHD) at three levels: behavioural, neuropsychological, and brain-based. Mindfulness meditation increases focus and reduces distractibility. Twice-exceptional students, who are both gifted and have disabilities, live in two worlds: one where they are valued for their talent and another where they are misunderstood or reprimanded because of their disability. Attention, social, behavioural, organisational, and academic difficulties can be exacerbated by ADHD, and mindfulness training can provide support. In conclusion, mindfulness is a valuable tool for improving cognitive skills, attention, and mental health, especially for gifted students who often struggle with executive function skills such as time management, study habits, and preparation [15].

Research Hypothesis

The study aimed to test the following null hypothesis:

There is no statistically significant effect of using mindfulness training strategies on improving the working memory efficiency of twice-exceptional gifted female middle school students across the three measurements (baseline, mid-point, and post-intervention) at a significance level of $\alpha = .05$.

Research Problem

Gifted students often exhibit high cognitive abilities, but their efficiency of working memory is affected by ADHD. Cognitive psychologists have proposed strategies to improve working memory efficiency, but the factors influencing these abilities and interventions are not fully understood. This is particularly relevant for twice-exceptional gifted students who are both gifted and suffer from ADHD. Researchers in Saudi Arabia are exploring the impact of cognitive interventions on

developing the cognitive abilities of twice-exceptional gifted female middle school students. Studies have shown that such interventions have a positive and effective impact on enhancing cognitive abilities, particularly working memory. The study aims to answer the main research questions:

- What is the effect of using mindfulness training strategies on improving the working memory efficiency of twice-exceptional gifted female middle school students across three measurements (baseline, mid-point, and post-intervention)?
- What are the perceptions of the participating students regarding the impact of mindfulness training strategies on enhancing their working memory efficiency after the intervention?

Significance of the Study

The study focuses on the impact of cognitive interventions on improving working memory efficiency among gifted students, particularly twice-exceptional students, and the applications of cognitive psychology in talent development. It is a pioneering attempt within the Arab world, particularly Saudi Arabia, to employ cognitive interventions to enhance cognitive processes among gifted students. The study focuses on a specific subgroup of twice-exceptional students whose giftedness conceals ADHD manifestations, an under-researched group globally and within Saudi Arabia. The study provides theoretical insights for practitioners and researchers in cognitive psychology regarding the effectiveness of mindfulness training strategies in improving working memory efficiency among twice-exceptional students. It contributes to gifted education by offering scientific evidence that can guide practitioners and stakeholders in implementing cognitive interventions to develop young talents, particularly in the context of human capital development, a core pillar of Saudi Arabia's Vision 2030.

Parents of gifted students may benefit from the findings by deepening their understanding of their childrenɔs abilities and the role of cognitive interventions in enhancing these abilities. The findings offer valuable insights for researchers and staff at the King Abdulaziz and His Companions Foundation for Giftedness and Creativity, enabling them to enhance institutional outcomes, particularly concerning twice-exceptional students whose giftedness masks ADHD symptoms.

Definition of Terms

- *Twice-Exceptional Gifted Students* are students officially identified as gifted but who also suffer from ADHD, where their giftedness conceals the symptoms of the disorder (i.e. giftedness masking disability). Twice-exceptional gifted students are students who show high potential in certain areas and weak potential in others, making it difficult to take a definitive stance on whether they are genuinely gifted or suffer from learning disabilities. In the context of this study, the term is limited to officially recognised gifted female middle school students who concurrently exhibit ADHD symptoms [16].
- *Working Memory Efficiency* is the ability to maintain information in an active, easily accessible state while resisting interference from irrelevant information, such as remembering a new phone number long enough to dial it or retaining the

time and date of an important meeting until it can be recorded [17]. Operationally, it is defined as the total score achieved by the examinee on the working memory efficiency scale utilised in this study.

Study Limitations

The generalisation of the results of the current study is subject to the following limitations:

- *Objective Limitations*. The study focuses on examining the effect of mindfulness training on improving working memory efficiency among gifted twice-exceptional female middle school students.
- *Time Limitations*. The study was conducted in the academic year 2024/2025.
- *Spatial Limitations*. The study was conducted in the public schools in the western region of the Kingdom of Saudi Arabia (Mecca, Jeddah, Taif).
- Human Limitations. The study sample consists of middle school female students who have been officially identified as gifted and simultaneously exhibit symptoms of attention-deficit/hyperactivity disorder (ADHD).

Literature Review

Theoretical Framework

Working Memory

Working memory is a crucial brain system responsible for the temporary storage and processing of information essential for language comprehension, learning, and logical thinking. It can hold a limited amount of information, either abstract ideas or tangible objects. Adults have a working memory capacity of approximately 3–4 items, while preschool and early elementary children can store about 2–2.5 items. Working memory and short-term memory are related but differ in function [18].

A. D. Baddeley and G. Hitch [19] presented a model of working memory comprising the central executive system and two subsidiary systems. The central executive manages working memory, processing, and storage of information, determines the significance and priorities of incoming data, divides incoming information, controls attention and decision-making, and transfers information from long-term memory through rehearsal and recoding. It consists of two subsystems: the phonological loop and the visuospatial sketchpad.

Executive attention plays a critical role in distinguishing important elements from a large number of other sensory stimuli. Executive attention plays a crucial role in modifying encoding to enhance working memory efficiency. A noticeable decline in executive attention processes leads to individuals' inability to solve problems they encounter. The development of cognitive potentials in an individual depends on a complex dynamic interaction between genetic, behavioural, and environmental factors. Biological aspects associated with genetic factors can also contribute to the development and expression of an individual's potential alongside the other three factors [19].

According to B. Trail, twice-exceptional gifted students are students who show high potential in certain areas and weak potential in others, making it difficult to take a definitive stance on whether they are genuinely gifted or suffer from learning disabilities. Despite the debate around the concept, the presence of such students in schools remains one of the most challenging issues teachers face due to the contradictory characteristics displayed by these students, which complicates the task of teaching them [20].

According to R. Qur'ani and S. Syafril, definiting twice-exceptionality is challenging due to the multifaceted nature of these students. They may possess high abilities in one or more areas while having a disability that affects their learning or social-emotional functioning. This duality often results in asynchronous development, where their advanced cognitive abilities interact with significant difficulties in attention, executive functions, or emotional regulation. Twice-exceptional students may excel in abstract thinking but simultaneously suffer from dysgraphia. This contradiction affects the process of identifying them, as teachers might focus either on the disability or the talent, neglecting the interaction between the two [21].

According to A. E. Kranz, T. A. Serry and P. C. Snow, disabilities that may accompany the talents of twice-exceptional individuals include specific learning disabilities, speech and language disorders, emotional/behavioural disorders, physical disabilities, autism spectrum disorders (ASD), or other disorders such as attention deficit hyperactivity disorder (ADHD). These disabilities combine with high abilities to create a unique group of students who may fail to demonstrate high academic performance, while at the same time their specific disabilities may not be easily noticeable. Thus, meeting the multiple needs of twice-exceptional individuals correctly is challenging [22].

Fig. 1. Twice-exceptional profiles source [23]

The colour green represents twice-exceptionality, a group of students who exhibit both giftedness and learning difficulties. This group is often misdiagnosed due

to their high abilities, leading to confusion and frustration. Early identification is crucial, but diagnosis is often delayed until adolescence. Misdiagnosis can result in negative consequences such as social isolation, low self-esteem, depression, or academic dropout.

Mindfulness has been shown to be effective in helping twice-exceptional individuals. Studies have shown that a yoga programme based on meditation can reduce hyperactivity, increase attention, reduce anxiety, and improve peer relationships. Additionally, incorporating motor exercises within mindfulness programmes can enhance brain functions and improve attention. Mindfulness techniques can help students acquire knowledge and confidence in areas of executive functions and non-cognitive factors they previously lacked [24].

In conclusion, understanding the characteristics of twice-exceptional individuals is crucial for accurate identification and support. Mindfulness techniques can help students acquire knowledge and confidence in areas of executive functions and non-cognitive factors they previously lacked.

Previous Studies

T. Desvaux, J. Danna, J. L. Velay et al. [25] established that certain people have high levels of intellect as well as learning, emotional, or neurodevelopmental issues, raising the question of whether compensatory or aggravating psycho-cognitive mechanisms behind their observed behaviour. Clarifying this will help to answer issues about the potential need for differential diagnosis tools, as well as specialised educational and clinical assistance. A meta-review of recent discoveries from neuroscience and developmental psychology might aid in the creation and evaluation of intervention techniques.

A. N. Aboalola [26] explored how a mindfulness-based intervention improved executive functions and reduced symptoms of attention deficit hyperactivity disorder in young children. A mindfulness-based intervention is being offered to 56 children aged 5–7 with ADHD or signs of inattention and hyperactivity (*mean* = 6.9, *SD* = 1.7). A pre-post-follow-up test and multiple comparisons were utilised to see if there were any significant differences in executive functions and attention deficit hyperactivity disorder symptoms between the two independent (unrelated) groups.

Pretest evaluations were given to both the control and training groups. After the pretest, four weeks of instruction were reserved for the intervention group alone. The T-test results for differences in post-test mean scores between the two groups in Executive Functions (EF) and Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms showed that the training group outperformed the control group. There were significant changes in EF and ADHD symptoms between pre and post measurements, preferring the post test, and between pre and follow-up measurements, favouring the follow-up test, but no statistical differences between post and follow-up testing. This study demonstrates that it is possible to increase EF abilities through a mindfulness-based intervention in which young people with ADHD engage in a series of group play activities [31].

A. Yaghoobi and S. Farzin's [27] study used an A-B design to investigate the effects of mindfulness training on working memory capacity in dyslexic children. The data were analysed using a paired t-test. The findings revealed that the mindfulness training programme had a substantial effect on enhancing the working memory capacity of dyslexic children in three areas: central executive, phonological loop, and visual spatial sketchpad. The findings show that teachers and therapists utilise mindfulness practices as an independent or supplemental treatment strategy to improve the working memory capacity of dyslexic youngsters.

G. S. Bajestani, A. Ghanizadeh, F. Makhloughi [28] developed a mindfulness intervention programme that combined face-to-face and group instruction with personalised technology-accessible activities. The study sought to investigate the impact of Blended Mindfulness Intervention (BMI), which blends conventional mindfulness practices with digital technologies, on university students' sustained attention, working memory, academic success, and electroencephalogram (EEG) asymmetry. The findings of statistical analysis using independent samples t-tests confirmed BMI's effectiveness in improving university students' sustained attention, working memory, and academic performance. The study of EEG readings using a 19-channel device revealed a drop in theta/beta ratio (TBR) values in all brain areas, including frontal, parietal, occipital, and central, after the test. The ratio is a common statistic used in EEG research to evaluate brain activity. The study revealed that encouraging state mindfulness in MT programmes fosters trait mindfulness, which has a variety of cognitive, emotional, social, and metacognitive effects. It also indicated that augmenting face-to-face and group treatments with individualised, simply available, and economical ones seemed to adapt to all types and preferences, hence increasing the efficiency of these programmes.

A. A. Alarfaj, M. M. Hassan, R. M. Aljohar et al. [29] used a qualitative case study technique with three male Paralympic winners (mean age 33 years). Achievement portfolios and in-depth interviews were used to gather information about the athletes' living experiences and identify relevant developmental elements. The study revealed two unique developmental phases. The first stage, marked by spontaneous and unstructured drive, was influenced by psychological and social factors that inspired widespread interest in sports. The second level entailed purposeful goal planning and disciplined practice in specialised sports venues. Individual growth traits and physiological development were important variables in determining each stage progression. The study emphasises the intricate interaction of personal, psychological, social, and environmental aspects in the development of performance excellence in twice-exceptional Paralympic competitors. This study advances our understanding of how focused assistance and acknowledgement of developmental requirements may create long-term sports performance.

R. García-Perales, A. Rocha, A. Aguiar et al. [30] examined the idea of strong intellectual capacities via a terminological lens, focusing on its unique approach in the Portuguese educational system. It describes the present conceptual difference in the realm of higher abilities, emphasising how the primary qualities are articulated

as well as the strengths and limitations of current teaching and learning practices in Portugal. Educational work with these students in Portuguese schools is marked by unequal regulation in comparison to other educational needs, an imbalance of educational processes aimed at these gifted students, and a clear underdiagnosis, which can lead to their being ignored in the classroom, harming their overall development as well as their academic and professional careers. The paper emphasises the importance of teacher training in Portugal as a factor that could be critical in closing the educational gap to the greatest extent possible – which currently includes educational inclusion for all students as one of the key action principles in the Portuguese educational system.

Methods

The present study aims to investigate the effect of a cognitive intervention strategy based on mindfulness in improving working memory efficiency among gifted twice-exceptional female middle school students in public schools in the western region of the Kingdom of Saudi Arabia. To achieve the research goals, a mixed-methods approach was adopted, combining an experimental design using repeated measures design (Pretest-Posttest Control Group Design with Repeated Measures). This design allows for examining the causal relationship between the independent variable (the intervention) and the dependent variables (test results). The existence of both experimental and control groups helps control for external influences and ensures the reliability of the results. Repeated measures design allows for multiple assessments (before, during, and after the intervention) on the same participants, providing the opportunity to assess the intervention's effects over time and compare differences between the two groups across three time points. Additionally, qualitative methods were employed, including in-depth interviews with the participants after the training programme, to explore their perceptions of the programme and its effect on their attention control.

The Population and Sample of the Study

The study population consists of all gifted twice-exceptional middle school students in the cities of Mecca, Jeddah, and Taif, as shown in Table 1, who have been identified as gifted and exhibit symptoms of ADHD. Due to the difficulty of conducting a comprehensive survey of the gifted students' population to derive a subpopulation that includes twice-exceptional gifted students – those with giftedness and ADHD symptoms – the study focused on selecting samples to verify the validity and reliability of the study tools and experimental study samples.

Table 1

Gifted student population in Mecca, Jeddah, and Taif

City	Mecca	Jeddah	Taif	Total
Number of gifted students	826	1921	498	3245

The purposive sampling method was used, which is a non-probability sampling technique. In this method, participants who have specific characteristics related to the research topic are selected based on predetermined criteria that align with the objectives of the study. This method is often used in qualitative or mixed-methods studies that aim to understand complex phenomena or target hard-to-reach populations. While this approach reduces the generalisability of the results, it enhances their credibility by targeting participants who can effectively contribute to the objectives of the study.

In most psychological and educational studies, research populations are clearly defined, and researchers follow certain criteria to select individuals who share specific characteristics. These individuals form the sample, which is then used to apply the research tools prepared by the researcher or pre-established and modified. In this study, students' giftedness was determined based on the detection system used in Saudi Arabia by the King Abdulaziz and His Companions Foundation for Giftedness and Creativity. The major challenge in defining the study sample lies in identifying students who exhibit ADHD symptoms in addition to being gifted, thus classifying them as twice-exceptional. The following steps were taken to obtain a sample that meets the objectives of the study:

- Applying the ADHD rating scale for adolescents through Google Forms, with the teachers provided with the link to the survey.
- Analysing the results using Saudi criteria to include students who scored a raw score of 19 or higher in the hyperactivity and inattention dimensions, and a total raw score of 35 or higher, to move to the next phase.
- Applying the ADHD rating scale for adolescents – Home/Family version, through Google Forms, with families provided with the link to complete the assessment.
- Analysing the results using Saudi criteria to include students who scored a raw score of 17 or higher in the hyperactivity and inattention dimensions, and a total raw score of 34 or higher to proceed to the next phase.
- Analysing the work samples from students who passed the previous phases to move on to phase six.
- Conducting interviews with the students who passed the previous phases and applying the ADHD interview tool for adults (DIVA), which was obtained from the official DIVA website (www.divacenter.eu).
- Analysing interview results and applying the tool's correction criteria to include students who scored an average of 6 or higher in the hyperactivity and inattention dimensions to proceed to the final stage, confirming the presence of ADHD symptoms.
- Creating a final list of twice-exceptional students based on their scores in the previous stages for inclusion in the study sample.

After applying the previous procedures through the sequential phases on 450 gifted students, 30 twice-exceptional students were selected as an exploratory sample to apply the main study tools (working memory scale and structured interview)

and confirm their validity and reliability. Table 2 shows their distribution according to the sampling stages and geographical areas of the study.

Table 2

Distribution of the exploratory sample according to sampling stages and geographical areas

Stage	Procedure	Mecca	Jeddah	Taif	Total
First	Application of ADHD Rating Scale for Adolescents (School and Home Versions) by sending the application link to all public and private schools	826	1921	498	3245
Second	Collection of completed responses from schools and preparation for statistical analysis	148	190	112	450
Third	Inclusion of students with raw scores of 19 or higher on hyperactivity and inattention, and total raw scores of 35 or higher in the school version; and students with raw scores of 17 or higher on hyperactivity and inattention, and total raw scores of 34 or higher in the home version	18	27	13	62
Fourth	Collection and analysis of work samples from students selected in previous stages	18	27	13	62
Fifth	Conducting interviews with students who passed previous stages and applying the ADHD Interview for Adults (DIVA)	18	27	13	62
Sixth	Inclusion of students with an average score of 6 or higher on hyperactivity and inattention	16	26	12	54
Seventh	Creation of a final list of twice-exceptional students ordered descendingly by their scores in previous stages for inclusion in the study sample	16	26	12	54
Final sample	16	26	12	54	

The main sample consisted of 24 twice-exceptional students (gifted and simultaneously exhibiting symptoms of attention deficit and hyperactivity disorder). These students were randomly selected from the subpopulation formed according to the previously mentioned stages. They were also randomly assigned to the mindfulness-based intervention group (experimental group) and the control group (which did not receive any intervention). Table 3 shows their distribution by geographical areas of the study.

Table 3

Distribution of the main study sample by geographical areas (n = 24)

Group	Mecca	Jeddah	Taif	Total
Experimental	4	5	3	12
Control	4	5	3	12
Total	8	10	6	24

Study Tools

There are many internationally recognised tests for measuring working memory, and the present study used the Digit Span Test and the Visual-Spatial Drawing Panel Test. A detailed explanation of each test is presented below.

Digit Span Test. The method used in designing the Digit Span Test was adopted from [31, 32], in which numerical stimuli are presented to the participants (e.g. 5–8–3–1) either audibly or visually at a rate of one number per second, then disappear. Participants are asked to recall and write down the numbers. The forward span test (to remember the numbers in the same order they appeared) was used, as shown in Figure 2. Responses are scored based on the raw score of the total correct attempts: 2 points for a correct sequence of numbers, 1 point for recalling all numbers without sequence, and 0 points for failing to recall at least one number from the sequence [38]

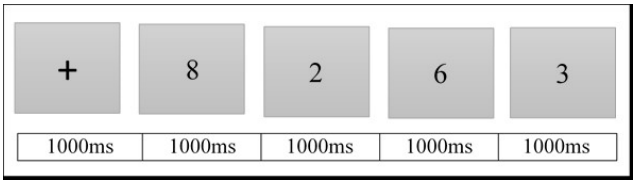

Fig. 2. Example of Digit Span Test items

Despite the high validity and reliability of the Digit Span Test, it was applied to the exploratory sample of 30 students to calculate the correlation coefficients between the test items and the total score. All results were statistically significant at the ($\alpha = 0.05$) level, as shown in Table 4. This indicates that the construct validity criterion for the test was met, thus ensuring confidence in using it to measure working memory in twice-exceptional students.

Table 4

Correlation coefficients between items of the digit span test and the total score of the test ($n = 30$)

Item	Correlation coefficient	Item	Correlation coefficient
1	.403*	11	.377*
2	.335*	12	.256*
3	.336*	13	.287*
4	.367*	14	.379*
5	.375*	15	.478**
6	.334*	16	.566**
7	.283*	17	.555**
8	.275*	18	.338*
9	.268*	19	.279*
10	.283*	20	.300*

*Significant at ($\alpha \leqslant 0.05$)
** Significant at ($\alpha \leqslant 0.01$)

There are several methods for calculating the reliability of the Digit Span Test, such as internal consistency and test-retest reliability. However, A. R. A. Conway, M. J. Kane and R. W. Engle [34] indicated that an internal consistency coefficient between 0.70 and 0.90 is considered a strong indicator of reliability for the Digit Span Test. In the current study, reliability was verified by calculating the internal consistency reliability coefficient on the exploratory sample of 30 students, where the reliability coefficient was found to be 0.74, which is appropriate for the purposes of the current study.

Visuospatial Sketchpad Test

Educational and psychological studies are rich with different versions of this test, but it was adopted from L. Ma, L. Chang, X. Chen et al. [35] for its clear design of test items. In this test, stimuli containing a two-dimensional or three-dimensional grid of black and white squares are presented in sequence at a rate of one square per second [36]. The forward span is measured by recalling the squares in the same order in which they appeared, as shown in Figure 3. Participants' responses are scored by calculating the longest sequence of squares that were correctly recalled twice. The results are interpreted by judging the average forward span for adults, which is ± 6 squares [37]. If the average forward span is less than four squares, it indicates a weakness in spatial working memory [38].

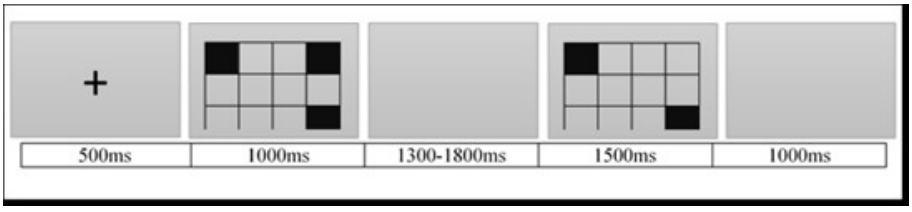

Fig. 3. Example of the visuospatial sketchpad test

The construct validity indicators for the test were extracted by administering it to the exploratory sample of 30 students to calculate the correlation coefficients between the test items and the total score. All of them were statistically significant at the level ($\alpha = 0.05$), as shown in Table 5. This indicates the achievement of construct validity criteria for the test, thus providing confidence in its use for measuring the working memory of twice-exceptional students.

Table 5

Correlation coefficients between items of the visuospatial sketchpad test and the total score of the test ($n = 30$)

Item	Correlation Coefficient	Item	Correlation Coefficient
1	.565**	11	.338*
2	.441**	12	.477**
3	.435**	13	.347*

4	.458**	14	.515**
5	.458**	15	.601**
6	.434**	16	.507**
7	.481**	17	.613**
8	.422**	18	.534**
9	.486**	19	.586**
10	.477**	20	.572**

* Significant at ($\alpha \leqslant 0.05$)
** Significant at ($\alpha \leqslant 0.01$)

The reliability of the test in its original form was calculated using the split-half method, where the reliability coefficient for response time was 0.614, which indicates the test has appropriate internal consistency [39]. In the current study, the same approach was followed to calculate the test reliability using the split-half method on the exploratory sample of 30 students, where the coefficient was found to be 0.67, indicating the test adequacy for measuring the visual working memory of twice-exceptional students.

Mindfulness-Based Intervention Programme

The general objectives of the programme is to enhance the working memory efficiency of twice-exceptional gifted female middle school students using mindfulness-based cognitive intervention and improve the emotional and social aspects of twice-exceptional gifted female middle school students.

The specific objectives stem from the general aims and focus on improving working memory efficiency by developing the following skills: emotion recognition, awareness of thoughts and conscious observation, attention focusing and maintenance, monitoring and description, judgment, mindful thinking, mindful action, present-moment orientation, openness to new experiences, and self-motivation.

Theoretical Foundations of the Training Programme

Mindfulness training is grounded in several theoretical frameworks that support its application and its positive impact on individuals, particularly gifted students. The main theoretical bases include:

- *Cognitive-Behavioural Theory (CBT)*. This theory posits that thoughts and emotions directly influence behaviour, and thus behaviour can be modified by improving cognitive awareness and enhancing conscious thinking. Mindfulness trains individuals to observe their thoughts and feelings without reacting impulsively, which enables more thoughtful responses. This theory supports activities like mindful meditation that help neutralise negative thought patterns.
- *Self-Determination Theory (SDT)*. This theory emphasises the human need for autonomy, competence, and relatedness to achieve personal growth. Mindfulness enhances individuals' sense of control over their thoughts and behaviours, promoting autonomy and emotional engagement in learning.
- *Social Cognitive Theory*. It highlights learning through observation and interaction with the environment, emphasising that individuals can regulate their thoughts and behaviours. Mindfulness helps students interact consciously with

their social environment, improving their ability to build healthy relationships and respond positively to life challenges.

- *Situational Awareness Theory.* This theory underscores the importance of individuals being aware of their environment and contextual surroundings. Mindfulness increases situational awareness and the ability to make appropriate decisions based on comprehensive understanding of current conditions.

Implementation Procedures of the Programme

The programme consists of 21 training sessions delivered over seven weeks at a rate of three sessions per week. Part of the training is conducted at the Center for Development and Training under the Education Directorate in Mecca due to its suitable and spacious facilities, while the remaining sessions are held at schools.

Student-centred training strategies are used to ensure better engagement, such as brainstorming, role-playing, discussions, and case studies. The target group includes twice-exceptional (2e) gifted female middle school students – those who show high abilities while simultaneously facing various sensory and cognitive challenges.

Training materials include: computers, data projectors, pens and paper, whiteboards, worksheets, videos, websites, brochures, headphones, flashcards, and microphones. The programme is scheduled to be implemented during the first semester of the 2024–2025 academic year, with sessions held three times per week over a 10-week period. Each session lasts approximately 80 minutes and is integrated into the students' regular daily schedules.

Programme Validity

To ensure the theoretical and skill-based soundness of the programme and its content, the Delphi method was used for validation. A panel of experts in gifted education, creativity, and psychology reviewed the programme and provided feedback on its goals, sessions, and alignment with the content and the target group. Their suggestions were incorporated into the final version of the programme. A 90% agreement rate among experts was achieved, confirming the appropriateness of the sessions and the overall programme content.

Results

To answer the first research question, which states, "Are there statistically significant differences at the significance level ($\alpha \leqslant 0.05$) between the mean scores of pre-test, mid-test, and post-test working memory efficiency for the experimental group that underwent cognitive interventions and the control group that did not, among gifted students with dual exceptionalities in middle schools in Saudi Arabia?", the means and standard deviations of the total scores for both the experimental and control groups on the pre-test, mid-test, and post-test of working memory efficiency were calculated, as shown in Table 6.

Table 6

The experimental and control groups on pre-test, mid-test, and post-test working memory efficiency

Group	Measurement	Mean	Std Devi.	Minimum	Maximum
Experimental	Pre-test	24.667	0.397	23.844	25.490
	Mid-test	29.083	0.417	28.218	29.948
	Post-test	35.083	0.346	34.366	35.801
Control	Pre-test	25.083	0.397	24.260	25.906
	Mid-test	25.500	0.417	24.635	26.365
	Post-test	25.667	0.346	24.949	26.384

Table 6 shows visible differences between the experimental and control groups in the pre-test measurement, with the mean score for the experimental group being 24.667 and for the control group being 25.083, indicating a slight difference of 0.417. Since these differences are relatively small, this confirms the equivalence of the two groups before implementing the cognitive intervention programme. The results also show visible differences between the two groups on the mid-test, where the control group had a mean score of 25.500 and the experimental group had a mean score of 29.083, representing a noticeable difference of 3.583 in favour of the experimental group. Similarly, the results show visible differences between the groups on the post-test, with the control group having a mean score of 25.667 and the experimental group having a mean score of 35.083, indicating a significant difference of 9.417 in favour of the experimental group. Compared to the pre-test difference of 0.417, the differences between the pre-test and post-test for both groups are considerably larger, as shown in Figure 4.

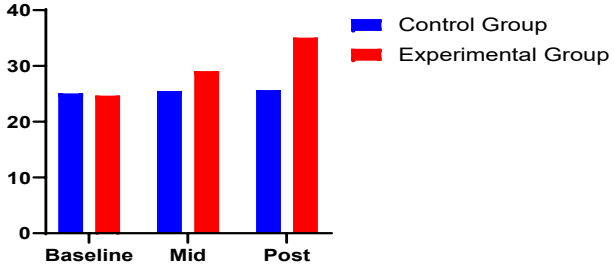

Fig. 4. Differences between the experimental and control groups across the three measurements (baseline, mid-test, and post-test)

To verify the statistical significance at the level ($\alpha \leqslant 0.05$) of the differences between the control and experimental groups on the pre-test, mid-test, and post-test of working memory efficiency, Multivariate Analysis of Variance (MANOVA) was used to isolate the difference between the groups' scores on the pre-test as shown in Table 7.

Table 7

The differences between the control and experimental groups on pre-test, mid-test, and post-test working memory efficiency

Source of variance	Effect	Value	F-value	D.f.	Standard error	Sign.	Eta squared
Working memory	Pillai's Trace	0.969	327.204b	2.000	21.000	0.000	0.969
	Wilks' Lambda	0.031	327.204b	2.000	21.000	0.000	0.969
	Hotelling's Trace	31.162	327.204b	2.000	21.000	0.000	0.969
	Roy's Largest Root	31.162	327.204b	2.000	21.000	0.000	0.969
Working memory group	Pillai's Trace	0.961	258.361b	2.000	21.000	0.000	0.961
	Wilks' Lambda	0.039	258.361b	2.000	21.000	0.000	0.961
	Hotelling's Trace	24.606	258.361b	2.000	21.000	0.000	0.961
	Roy's Largest Root	24.606	258.361b	2.000	21.000	0.000	0.961

Table 7 indicates statistically significant differences between the control and experimental groups on the pre-test, mid-test, and post-test working memory efficiency, with a significance value of 0.000. Since this value is less than 0.05, it indicates a significant interaction between the groups (experimental and control) and time (pre-test, mid-test, and post-test), confirming that the cognitive intervention programme effect differs across the various time points of measurement.

It is worth noting that the previous result confirms the rejection of the null hypothesis, which states: "There are no statistically significant differences at the significance level ($\alpha \leqslant 0.05$) between the mean scores of pre-test, mid-test, and post-test working memory efficiency for the experimental group that underwent cognitive interventions and the control group that did not, among gifted students with dual exceptionalities in middle schools in Saudi Arabia".

Additionally, the Eta squared value (η^2) was 0.969 for working memory and 0.961 for the interaction between group and time, indicating that this interaction explains a large percentage of the variance in working memory scores between the two groups. This suggests that approximately 96% of the improvement in the work-

ing memory efficiency scores in the post-test for the experimental group is attributed to the cognitive intervention programme provided.

To determine the direction of the differences by group, pairwise comparisons of working memory efficiency between the individuals in the control and experimental groups were conducted, as shown in Table 8.

Table 8

Post-test pairwise comparisons of working memory efficiency between individuals in the control and experimental groups

Group	Group	Mean difference	Standard error	Sign.
Experimental	Control	4.194*	0.501	0.000
Control	Experimental	-4.194*	0.501	0.000

Table 8 shows statistically significant differences between the control and experimental groups in mean working memory efficiency scores in favour of the experimental group that received the cognitive intervention programme.

To determine the direction of the differences by the mean scores on the working memory measures, pairwise comparisons were conducted on the three measurements (pre-test, mid-test, and post-test) for the experimental group, as shown in Table 9.

Table 9

Post-test pairwise comparisons of the total scores for the experimental group on the three measurements: pre-test, mid-test, and post-test

Measurement	Measurement	Mean difference	Standard error	Sign.
Pre-test	Mid-test	-2.417*	0.162	0.000
	Post-test	-5.500*	0.212	0.000
Mid-test	Pre-test	2.417*	0.162	0.000
	Post-test	-3.083*	0.203	0.000
Post-test	Pre-test	5.500*	0.212	0.000
	Mid-test	3.083*	0.203	0.000

Table 9 shows statistically significant differences between the three measurements. The mean difference between the pre-test and mid-test was 2.417 in favour of the mid-test, the mean difference between the pre-test and post-test was 5.500 in favour of the post-test, and the mean difference between the mid-test and post-test was 3.083 in favour of the post-test. This indicates that the students' scores on the working memory measures increased across the different time points, confirming that the improvement in the students' working memory scores can be attributed to the cognitive intervention programme provided to the experimental group. This underscores the effectiveness of the training programme in enhancing the working memory efficiency of gifted students with dual exceptionalities in middle schools in Saudi Arabia.

To answer the second research question which states, "what are the perceptions of the participating students about the impact of using mindfulness training strategy on improving their working memory efficiency after the experiment?", data were collected through interviews with the 12 students who participated in the training programme, and their opinions about their experiences with the mindfulness programme were gathered. The thematic analysis method was used to analyse the students' responses by coding these responses based on recurring themes about the training programme. NVivo qualitative data analysis software was employed to identify recurring patterns in the students' responses. The analysis aimed to identify the main themes related to the perceived effectiveness of the programme, its impact on cognitive functions (working memory), and the aspects that could be improved from the participants' perspectives. The analysis revealed several main themes: positive general acceptance and increased self-awareness, enhancement of cognitive skills, components of the programme and learning methods, and suggestions and recommendations for programme development.

Overall, the students reported a positive experience with the programme. Many of them indicated a noticeable improvement in their working memory, as well as gaining new perspectives on their thoughts and emotions. The majority of the students also recognised positive effects on their working memory after participating in the training programme. Eleven out of the 12 students reported a significant improvement in this area, including better organisation of thoughts, improved recall (especially academic information and details that were previously forgotten), and better retention of information. For example, they mentioned some helpful activities such as organising information, building knowledge, mindful meditation, pausing and thinking before reacting, and analysing daily situations. Some student responses include:

- Nora (Student 1): "I started organising my thoughts before studying … This has greatly improved my memory".
- Reem (Student 3): "My ability to remember during lessons has increased, and I understand faster".
- Hind (Student 9): "I started writing organised topics without forgetting the main idea".

Table 10 illustrates the main themes identified by classifying the responses into nodes in NVivo. It can be observed that the themes of improving focus and attention and the positive impact of the programme on working memory received the most attention from the students. In contrast, artistic activities like drawing did not receive much attention.

Table 10

Main themes identified from the categorisation of students' responses

Main theme	No. of students	Examples from responses
Improved Emotional Awareness	10	"I started understanding how my emotions affect my reactions"
Improved Focus and Attention	12	"I can concentrate in class despite the distractions"
Positive Impact on Working Memory	12	"I remember the steps in solving math problems faster"
Artistic Activities (e.g. Drawing)	5	"Expressing emotions through art helped me understand myself better"
Suggestions (e.g. additional sessions)	8	"I suggested adding sessions on managing anxiety during exams"

The relationships between sub-themes were identified using matrix coding queries in the analysis. Table 11 indicates that breathing exercises with executive attention were frequently mentioned in the students' responses, while the use of art for expression was mentioned less frequently.

Table 11

Relationships between sub-themes using matrix coding queries

Sub-theme	Working memory	Suggestions
Breathing Exercises	8	-
Pausing and Reflecting Activities	7	3
Group Activities	-	6
Use of Art for Expression	2	-

Table 12 shows the sessions and activities that received the most attention from the students. It can be observed that the emotional awareness session received the highest attention, while artistic activities ranked last.

Table 12

Sessions and activities that received the most attention from students

Session/Activity	No. of students	Reason for preference
Emotional Awareness	7	"It helped me understand how emotions affect behaviour"
Mindful Thinking	6	"It taught me to change negative thinking"
Pausing and Reflecting Activity	5	"It helped improve my memory and focus"
Artistic Activities (Drawing)	4	"It allowed me to express my feelings without words"

Table 13 shows the students' preferred training methods, with the most preferred method being practical application, while group projects received the lowest rank.

Table 13

Preferred training methods by students

Training method	Number of students who chose it
Practical Application	11
Training by Practice	8
Role Playing	5
Discussions	5
Case Studies	3
Group Projects	2

The students' suggestions were categorised using tree nodes. The most prominent suggestions included adding topics and activities like managing anxiety during exams and balancing study with hobbies. There were also suggestions to improve activities, such as incorporating educational video games and outdoor physical activities. Regarding training methods, students suggested increasing group activities and using short videos in training.

As for the challenges and problems the students faced during the training, they raised issues such as insufficient time for some activities and difficulty in commuting to the training location from their perspective.

Discussion

Given the significant attention directed towards gifted students, particularly those with dual exceptionalities, the present study aimed to explore the effect of different cognitive intervention strategies (mindfulness training) on improving working memory efficiency among middle school female students who were officially identified as gifted and whose talent was masked by Attention Deficit Hyperactivity Disorder (ADHD). These students are classified as part of the dual exceptional group (giftedness masking ADHD). The study also aimed to explore their perceptions regarding the impact of mindfulness training on their working memory efficiency.

In light of the previous results, the researchers conclude that cognitive interventions enhanced the working memory efficiency of gifted students with dual exceptionalities. The results demonstrated that the training had a significant impact on their cognitive structure. The noticeable increase in working memory efficiency among the experimental group showed that the cognitive intervention programme had a direct effect on improving cognitive performance. This programme helped enhance cognitive flexibility and the ability to reorganise information, leading to better utilisation of mental resources such as focus, attention, and improvements in storage and retrieval processes within working memory.

We believe that this result is largely logical, as it can be attributed to the intensive training throughout the programme duration and the mental stimulation used within the procedures, which could contribute to strengthening neural networks – i.e. the brain's ability to adapt and reorganise neural connections. These

procedures may explain the high improvement rate (about 99.7%) in the post-test of the experimental group, indicating that the cognitive interventions led to tangible changes at the brain level, ultimately improving the performance of the students in the experimental group.

Regarding the temporal variation in the results of the three measurements, from the researchers' perspective, they represent real indicators of gradual progress in performance improvement. The statistical differences between the three measurements confirmed that the change in working memory efficiency was not sudden but rather a cumulative result of the cognitive interventions over time. In the pre-test, the differences between the two groups were less clear, but as the programme was implemented, a gradual improvement appeared in the experimental group's performance in the mid-test, and the improvement peaked in the post-test.

Concerning the interaction between time and intervention, the results of the analysis of variance (ANOVA) showed that the interaction between time (measurement points) and the nature of the group (experimental vs. control) explained a large part of the variance in the performance of gifted students in terms of working memory efficiency. This interaction suggests that the differences between the two groups are not fixed but evolve over time due to the application of the cognitive intervention programme. We believe that the increase in the students' scores or the improvement in working memory efficiency is an additional clear indication of the training programme effectiveness. Pairwise comparisons between the three measurement points for response time showed a noticeable increase in the students' scores at each stage of measurement. Students' scores were higher in the mid-test compared to the pre-test and higher in the post-test compared to the mid-test. This confirms that gifted students with dual exceptionalities not only learned how to store information more effectively but also gained efficiency in retrieving it more quickly.

We also found that the rise in students' scores on the working memory tests reflected an improvement in mental processing speed, which is an important indicator of cognitive performance development. From this point, the researchers argue that the improvement in processing speed enhanced the students' confidence in their abilities and motivated them to continue adopting effective cognitive strategies. One logical justification we emphasise is that it is well-established in the scientific literature that focused cognitive interventions can lead to significant improvements in cognitive performance through intensive and continuous training. The results of the study align with this theory, as the training showed a cumulative effect on improving working memory efficiency, reflecting the brain's response to training challenges.

Undoubtedly, gifted students with dual exceptionalities exhibit high abilities in processing and applying information creatively. Therefore, applying a training programme aimed at improving working memory may have a greater impact compared to other groups, as these students benefited from their innate abilities to develop advanced cognitive strategies. We also believe that the gradual improvement in per-

formance and working memory efficiency suggests that repetition and practice were essential components of the cognitive interventions provided, aligning with learning theory, which emphasises the importance of repeated practice for improving performance and achieving efficiency in cognitive processes.

Thus, the current result emphasises the need for designing specialised cognitive programmes that focus on gifted and dual-exceptional students, as such programmes can contribute to enhancing cognitive efficiency and increasing processing speed, which will positively affect academic and professional performance in the future. Since the improvement came gradually over time, it is important to continue applying similar programmes and provide ongoing support to students to ensure the sustainability and development of these improvements in the long term.

It is worth noting that results such as these can inspire educational policymakers to adopt evidence-based training methods in curricula, particularly in schools with gifted or exceptional students, which will contribute to improving the overall quality of education and learning. Generally, the results of this study align with the study conducted by B. M. Nesrine, S. Jarraya and L. Caprioli [39], who found that mindfulness meditation was associated with higher levels of attention, working memory, spatial visual memory, and social behaviour in experimental groups. This also corresponds with the study performed by M. Chakrabarty and P. Shinde [40], who showed a significant decrease in attention deficit and hyperactivity symptoms and an improvement in working memory performance, along with a significant increase in brain activation related to tasks in the right parietal lobe of the experimental group after the intervention.

The results of the qualitative analysis using NVivo software showed that the mindfulness programme had a positive effect on the skills of dual-exceptional students in several aspects, consistent with previous literature on the effectiveness of mindfulness programmes in educational environments. The working memory of the dual-exceptional students improved, as the students indicated an increase in their ability to organise information and remember study steps. This can be explained through the impact of mindfulness on enhancing the brain's executive functions, as explained in the study by A. Chiesa, R. Calati and A. Serretti [41]. For example, one student reported, "The information organisation activity improved my focus", reflecting the connection between practical exercises and academic achievement [37].

The working memory improved among all participating students, as they reported their ability to resist distractions while studying. This result is attributed to the effectiveness of the exercises and activities used in the programme, such as "Stop and Think" and "Mindful Breathing", which enhance sustained attention, as noted in the study by A. Lutz, H. A. Slagter, J. D. Dunne et al. [42], who found that mindfulness practices improve performance on cognitive tasks. Additionally, group activities were associated with improved social interaction, a factor that enhances self-motivation according to the model developed by E.L. Deci and R.M. Ryan [43].

Moreover, the students' perceptions of emotions improved, which was one of the key topics mentioned by 10 students, who reported that the programme helped

them understand the impact of emotions on their daily behaviours. This result aligns with studies by J. Kabat-Zinn [44] and Y. Y. Tang, B. K. Hölzel, M. I. Posner [45], which suggest that mindfulness training enhances emotional awareness and facilitates emotional regulation. For example, one student mentioned, "Expressing emotions through art helped me understand myself", reflecting the role of creative activities in enhancing non-verbal emotional expression.

Regarding the students' suggestions on the programme future prospects, they focused on the need for additional sessions to address academic anxiety and balance between life and studies. These findings are consistent with several studies that confirm academic stress as one of the main barriers to student performance [44, 47] and that mindfulness-based interventions reduce anxiety and improve psychological resilience [45, 48]. Some students also suggested using technology (such as educational games) in the exercises, a trend supported by studies on the integration of digital media in education to increase interaction [46].

Conclusions, Implications and Recommendations

The cognitive intervention programme based on mindfulness training proved effective in enhancing the working memory efficiency of twice-exceptional gifted female students, as statistically significant differences were found in favour of the experimental group across all three assessments (pre, mid, and post). The improvement was not immediate but cumulative, indicating that cognitive and perceptual changes were the result of consistent, guided training. The programme enhanced neural flexibility and faster information processing in students, which was reflected in their ability to memorise, organise, and focus. It also contributed to improved emotional awareness, emotional regulation, and self-awareness – crucial areas for twice-exceptional students. Participants expressed high satisfaction with the programme and demonstrated awareness of improvements in academic performance, cognitive functions, and social behaviour.

Our research findings highlight the importance of integrating mindfulness programmes into enrichment plans for gifted and twice-exceptional students. Mindfulness appears to be a promising non-pharmacological training tool that can be adopted to enhance students' psychological and cognitive well-being. The programme can be implemented as part of educational and therapeutic support curricula in schools that serve special-needs groups. The findings pave the way for developing more inclusive educational strategies that account for neurodiversity and emotional variation in classrooms.

Our study recommends expanding the application of the programme to include both male and female twice-exceptional students across different educational stages. It also calls for training teachers and school counsellors on how to use mindfulness techniques with students with special needs. Furthermore, it recommends incorporating mindfulness activities into regular classes as part of psychological education or Social and Emotional Learning (SEL) sessions. Institutional and technical support should be provided to implement such programmes in schools through

partnerships with training and rehabilitation centers. Additionally, interactive media and educational games should be encouraged during sessions to increase students' motivation and engagement.

Our study also recommends conducting future research on the long-term impact of the programme on students' academic performance and social behaviour. Moreover, it suggests adapting the programme to include training for coping with academic stress, anxiety, and time management skills among gifted students.

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