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The effect of mindfulness-based interventions on enhancing attention control efficiency among twice-exceptional students in Saudi Arabia

B.M. Alotaibi[1], S.A. Alrashidi[2], A.A. Bahrawi[3]
King Faisal University, Al-Ahsa, Saudi Arabia.
E-mail: [1]221402360@student.kfu.edu.sa; [2]salrashidi@kfu.edu.sa; [3]att21ef2030@gmail.com

✉ *alotaibibadrya2@gmail.com*

Abstract. *Introduction*. Mindfulness practices encompass a set of cognitive training techniques designed to develop mechanisms of voluntary attention and metacognitive control. Their application helps enhance the effectiveness of coping strategies under stress, reduce psychophysiological stress levels, and optimise self-regulation functions as well as overall psychological well-being. *Aim.* The present study *aims* to investigate the impact of integrating mindfulness training into the curriculum on improving concentration among gifted adolescent girls with attention deficit hyperactivity disorder (ADHD) in relation to their perception of the curriculum. *Methodology and research methods.* In the first stage, an experiment was conducted to implement a training programme based on mindfulness strategies. Subsequently, during the qualitative research phase, in-depth interviews with the participants were analysed. The sample consisted of 24 students with twice-exceptionalities (giftedness and a diagnosed ADHD), randomly divided into two groups: experimental (n = 12) and control (n = 12). Four tests – the Stroop, Continuous Attention, Flanker, and Simon tests – were administered to measure attention levels before, midway through, and after the intervention. *Results.* The *results* revealed statistically significant differences between the control and experimental groups at all three testing stages, favouring the experimental group. This outcome is attributed to the effects of mindfulness training. Additionally, qualitative analysis using NVivo confirmed the positive impact of mindfulness practices on students' focus and executive functioning skills. *Scientific novelty.* The *scientific novelty* of this work lies in its focus on a specific category of students who are often overlooked in pedagogical research, as well as in the application of cognitive techniques tailored for gifted students with twice-exceptionalities. *Practical significance.* The proposed technique effectively enhances concentration, self-regulation, and cognitive performance in students.

Keywords: mindfulness-based intervention, concentration enhancement, reduction of psychophysiological tension, optimisation of self-regulation functions, twice-exceptional gifted students in Saudi Arabia

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Влияние практик осознанности на развитие функций внимания у одаренных учащихся с двойной исключительностью в образовательной среде Саудовской Аравии

Б.М. Алотаиби[1], С.А. Альрашиди[2], А.А. Бахрави[3]
Университет короля Фейсала, Аль-Ахса, Саудовская Аравия.
E-mail: [1]221402360@student.kfu.edu.sa; [2]salrashidi@kfu.edu.sa; [3]att21ef2030@gmail.com

✉ *alotaibibadrya2@gmail.com*

Аннотация. *Введение.* Практики осознанности (mindfulness) представляют собой комплекс когнитивных тренировок, нацеленных на развитие механизмов произвольного внимания и метакогнитивного контроля. Их применение способствует повышению эффективности копинг-стратегий в условиях стресса, снижению уровня психофизиологического напряжения, а также оптимизации функций саморегуляции и общего психологического благополучия. *Цель* – исследовать влияние интегрированного в обучающую программу mindfulness-тренинга на рост концентрации внимания у одарённых девочек-подростков с синдромом дефицита внимания и гиперактивности (СДВГ) при восприятии учебной программы. *Методология, методы и методики.* На первом этапе был проведен эксперимент по реализации в течение десяти недель обучающей программы, основанной на стратегиях осознанности. После этого на этапе качественного исследования были проанализированы глубинные интервью с участницами эксперимента. В выборку вошли 24 ученицы с двойным исключением (одарённые и одновременно с диагностированным СДВГ), случайным образом разделенные на две группы: экспериментальную (n = 12) и контрольную (n = 12). Для измерения уровня внимания использовались четыре теста (Струпа, непрерывного внимания, Фланкера и Саймона) до, в середине и после вмешательства. *Результаты* показали статистически значимые различия между контрольной и экспериментальной группами на всех трёх этапах тестирования в пользу экспериментальной группы, что объясняется эффектом mindfulness-тренинга. Качественный анализ с использованием NVivo подтвердил положительное влияние практик осознанности на концентрацию внимания и исполнительные навыки учащихся. *Научная новизна* работы заключается в обращении к особой категории учащихся, нередко остающейся за рамками педагогических исследований и в использовании когнитивных методик, адаптированных для одарённых учащихся с двойной исключительностью. *Практическая значимость.* Предложенная методика является эффективной для улучшения концентрации внимания, саморегуляции и когнитивной деятельности у учащихся.

Ключевые слова: практики осознанности, концентрация внимания, снижение уровня психофизиологического напряжения, оптимизация функций саморегуляции, одаренные учащиеся с двойной исключительностью в Саудовской Аравии

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Introduction

Mindfulness training aims to enhance individuals' capacity to use their positive energy to manage stress, reduce mental strain, and improve well-being and self-regulation. Mindfulness tasks focus on monitoring and perceiving the immediate conscious experience by attending non-judgmentally to internal and external stimuli, thus enhancing attentional control [1, 2]. Mindfulness training can complement tools from positive psychology, considered the science of positive subjective experience [3]. In this context, positive psychology interventions aim to promote valuable subjective experiences, develop character strengths, and improve individuals' engagement and well-being. According to S. I. Donaldson, J. Y. Lee and S. I. Donaldson [4], mindfulness practices can enhance the cognitive ability to focus thoughts on the present and elevate awareness, in addition to numerous other benefits. It can also be used as a supplement to positive psychology training focused on human flourishing, growth, optimism, and reduced negative emotions. This study is a continuation of the previous research by B. M. Alotaibi, S. A. Alrashidi and A. A. Bahrawi [5] on the impact of mindfulness-based strategy training on working memory in twice-exceptional students in Saudi Arabia.

For students to learn effectively in classrooms, they must be able to focus their attention, recognise multiple perspectives, identify the novelty and context of new information, and better comprehend the material [7–9]. Studies indicate that learner-centred classrooms incorporating mindfulness as a core element of the learning experience produce students capable of transferring knowledge to new situations, demonstrating greater creativity, and exhibiting more independent thinking [10–12].

Therefore, mindfulness training is a promising strategy to help students cope with negative environmental stress by focusing their attention on the present moment, enabling full engagement with classroom activities, and ultimately making learning and teaching more effective.

Research Problem

Although gifted students generally demonstrate high cognitive abilities, these abilities vary, particularly in terms of executive attention efficiency, especially for those with ADHD, which impacts cognitive performance. While cognitive psychologists have proposed several strategies to enhance executive attention in general learners, the factors influencing such abilities and the interventions that can improve them remain insufficiently understood – especially for formally identified twice-exceptional students (i.e. gifted and diagnosed with ADHD), who fall under one category of twice-exceptionality [13, 14].

With increasing interest in gifted programmes in Saudi Arabia, the researchers – being specialists in gifted education – recognised the need to explore the impact of various cognitive interventions on developing cognitive abilities in twice-exceptional middle school girls. This would help unlock their potential at this critical

developmental stage and nurture their talents effectively. Previous studies on the effect of cognitive interventions on executive attention efficiency among gifted students have indicated a significant positive impact on cognitive abilities in general and executive attention specifically [15, 16].

Specifically, the study sought to answer the following two main questions:

1. What is the effect of using mindfulness training on improving executive attention efficiency among twice-exceptional middle school girls across the three measurement points (baseline, mid-point, and post-intervention)?
2. What are the participants' perceptions of the impact of mindfulness training on their executive attention efficiency after the intervention?

Significance of the Study

One of the most notable features of this study is its focus on a subgroup of twice-exceptional students, a population that has been under-researched both globally and, more specifically, in Saudi Arabia. The study contributes theoretical knowledge to the field of cognitive psychology regarding the effects of mindfulness training on executive attention among twice-exceptional female students. The findings may benefit parents of gifted students by deepening their understanding of their children's abilities and the cognitive interventions that enhance them.

Additionally, this study could serve as an important resource for researchers in the Arab context and for practitioners at the King Abdulaziz and His Companions Foundation for Giftedness and Creativity (Mawhiba), by building on its results to improve institutional outcomes and talent development efforts. The study also offers practical insights for gifted education professionals on how to incorporate mindfulness training into programmes for twice-exceptional gifted students, particularly those with ADHD, to improve their executive attention efficiency.

Definitions of Terms

- *Twice-Exceptional Gifted Students* are students who are officially identified as gifted while also having ADHD. In the context of this study, this term specifically refers to middle school girls who are both gifted and diagnosed with ADHD.
- *Executive Attention* is defined as the mental process that enables an individual to selectively focus on relevant information for further cognitive processing while excluding irrelevant stimuli that might disrupt focus [17]. S. J. Luck and J. M. Gold [18] describe executive attention as a complex structure associated with working memory functions and high-level control for filtering important from numerous sensory elements. Procedurally, it is defined as the score obtained by the examinee on the auditory and visual executive attention scale used in this study.

Literature Review

Theoretical Framework

Mindfulness, Attention, and Twice-Exceptionality

J. E. Sharp and P. A. Jennings [19] believe that mindfulness helps gifted students cope with the challenges they face due to the asynchronous development of their abilities, with a specific focus on areas like self-regulation and openness to new experiences. Regarding the impact of mindfulness on individuals with Attention Deficit Hyperactivity Disorder (ADHD), E. Van de Weijer-Bergsma, A. R. Formsma, E. I. de Bruin et al. [20] suggested that mindfulness is effective on three levels: behavioural, neuropsychological, and neurological. The authors report other positive effects observed in studies involving individuals with ADHD. A. Moore and P. Malinowski [21] confirmed that mindfulness meditation increases focus and reduces distraction.

Twice-exceptional students often experience contradictory treatment: at times they are appreciated for their talents, while at other times they are misunderstood or reprimanded for their disabilities. Such inconsistent treatment and their attempts to understand themselves can be extremely confusing, especially if ADHD significantly affects their social perception [22]. Attention, social, behavioural, organisational, and academic difficulties may be exacerbated by their dual exceptionalities. Therefore, ongoing education throughout adolescence is essential, with a focus on executive functions, social skills, and non-cognitive factors to mitigate challenges arising from differences in learning abilities, talent, or both. Mindfulness training can offer such support. M. L. Conejeros-Solar, M. P. Gómez-Arizaga, R. M. Schader et al. [23] also affirmed that twice-exceptional students struggle with executive function skills, negatively affecting time management, study habits, and preparation.

Executive Attention

Executive control is known by several synonymous terms such as cognitive control, executive function, or attentional control. It reflects an individual's ability to regulate information processing during goal-directed behaviour [24]. It is a core cognitive process enabling selective focus on goal-related information while inhibiting distractions, thus guiding behaviour and enhancing task performance. Attentional control functions through dynamic interactions between different brain networks, particularly the prefrontal cortex, anterior cingulate cortex, and parietal areas, prioritising sensory input and cognitive resources [25].

Attentional control plays a vital role in enabling individuals to maintain focus on task-relevant information while resisting distraction. Its primary function is to support goal-directed behaviour and ignore both internal and external sources of distraction [26]. According to M. I. Posner, M. K. Rothbart and Y. Y. Tang [27], attentional control includes three main subprocesses: selective attention (focusing on specific stimuli while ignoring irrelevant ones), sustained attention (maintaining focus over extended periods), and attentional shifting (flexibly redirecting attention as task demands change).

Attention and Mindfulness

Attentional control can be learned and trained as a fundamental element in mindfulness practices. Conversely, mindfulness practices contribute to the development of attention. Brain imaging studies of individuals with ADHD have shown increased frontal activity following mindfulness-based interventions [28].

A. P. Burgoyne, C. A. Mashburn, J. S. Tsukahara et al. [29] noted that mindfulness helps focus attention on relevant aspects of external events and internal processes through attentional shifting, enhancing the selection of relevant information and the allocation of appropriate cognitive processes, thereby acting as a gateway for information flow in the brain. Mindfulness practices direct attention to present sensations (e.g. breathing), increasing the individual's ability to concentrate and shift attention. Focused attention meditation strengthens internal attention, while open monitoring meditation enhances non-reactive awareness of stimuli [30].

Given the multitude of competing inputs individuals face, attention plays a crucial role in controlling these inputs based on current capacity and reducing the amount of information the brain must process [31–33]. Attention is essential not only for learning and information processing but also for emotional and behavioural well-being. Attentional flexibility helps regulate emotions by filtering out negative information and focusing on positive aspects. Those skilled in regulating their attention and emotions tend to have better social standing [34, 35].

Twice-Exceptional Learners

R. Callard-Szulgit [36] defined twice-exceptional individuals as those who possess high abilities in one or more areas alongside a disability that affects their learning or social-emotional functioning. This duality often leads to asynchronous development, as their advanced cognitive abilities interact with significant challenges in attention, executive functioning, or emotional regulation. S. M. Reis, S. M. Baum and E. Burke [22, p. 154] added that these students need tailored interventions that both nurture their talents and address their disabilities, emphasising that "the coexistence of giftedness and disability requires a holistic educational approach balancing enrichment with accommodation".

A twice-exceptional student might excel in abstract thinking while simultaneously struggling with dysgraphia. This contradiction complicates identification, as educators may focus solely on the disability or the talent, overlooking the interaction between the disability or the talent [37]. Disabilities accompanying the talents of twice-exceptional learners may include specific learning difficulties, speech and language disorders, emotional/behavioural disorders, physical impairments, autism spectrum disorders (ASD), or other conditions such as ADHD [38]. These disabilities, when combined with high abilities, create a unique student profile – one where academic excellence may not be apparent, and where the disability may mask the talent or vice versa. Consequently, S. M. Reis, S. M. Baum, and E. Burke [22] pointed out, addressing the multifaceted needs of twice-exceptional students is particularly challenging. S. M. Baum, R. M. Schader and S. V. Owen [37] illustrated the challenges and strengths of twice-exceptional learners using blue and yellow coding, respectively, as shown in Figure 1.

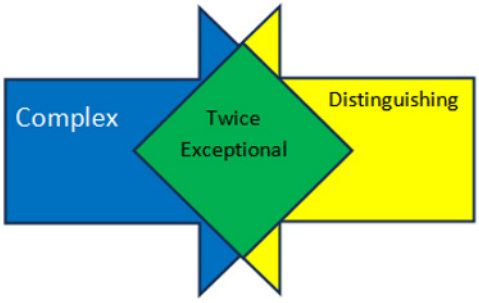

Fig. 1. Twice-exceptional cases, source: S. M. Baum, R. M. Schader and S. V. Owen [37]

The yellow colour represents high abilities, commonly referred to as giftedness – skills and capabilities that exceed the average in one or more domains. The blue colour indicates complex challenges (such as specific learning disabilities, ADHD, oppositional defiant disorder, generalised anxiety disorder, autism spectrum disorder) that hinder academic or social performance. The green colour symbolises twice-exceptionality – individuals who simultaneously possess both giftedness and learning, psychological, or social difficulties. The combination of these contrasting exceptionalities results in the green colour (twice-exceptional) as shown in Figure 1. It indicates that the nature of twice-exceptionality (green) is not fixed; rather, individuals may constantly shift along the continuum from yellow to blue, influenced by time, environment, and circumstances. Thus, twice-exceptional learners appear across a wide spectrum of green [38].

Despite the limited research on mindfulness and twice-exceptionality, existing studies have demonstrated its effectiveness for this important group of students. N. A. Gonzalez, N. Sakhamuri, S. Athiyaman et al. [39] reported that yoga programmes based on meditation show positive effects for children with ADHD, including reduced hyperactivity, increased attention, reduced anxiety, and improved peer relationships. H. Bigelow, M. D. Gottlieb, M. Ogrodnik et al. [40] suggested that motor activities included in mindfulness programmes enhance brain function, positively impacting attention. Mindfulness techniques can also help students gain knowledge and confidence in executive functioning and non-cognitive areas where they previously struggled [40, 41].

Previous Studies

E. Hammerdahl, L. M. Hilt, A. Draheim et al. [41] examined the effect of a brief self-awareness mindfulness technique on enhancing attention control and reducing mental fatigue in individuals. The sample included 77 university students with high levels of mental fatigue, selected randomly and exposed to a two-week intervention based on brief self-awareness training. Researchers used a self-report measure of self-awareness, a mental fatigue scale, and two tasks measuring attention control

(antisaccade and emotional go/no-go), applied both before and after the intervention. Results showed that the brief mindfulness intervention significantly improved attention control, reduced mental fatigue, and increased self-awareness scores in the experimental group compared to the control group.

B. M. Nesrine, S. Jarraya and L. Caprioli [42] investigated the effect of eight weeks of mindfulness meditation sessions on cognitive variables such as attention in 45 adolescents aged 16 with intellectual and developmental disabilities. Participants were randomly divided into three groups of 15: a mindfulness meditation group, a physical activity group, and a control group. Working memory was measured using a digit span task, the Corsi Block-Tapping Task for visuospatial working memory, a self-esteem scale, and a social responsiveness scale. Both experimental groups participated in two weekly sessions – mindfulness for 30 minutes and physical activity for 45 minutes. Using repeated-measures two-way analysis, results showed that mindfulness meditation was associated with higher levels of attention, visuospatial working memory, and social behaviour in the experimental groups. However, no significant effect was observed on verbal working memory or self-esteem.

M. A. Hammad and H. A. B. Shalhoub [43] examined the effectiveness of a self-awareness-based programme in improving self-regulation and attention among children with hearing impairments in Najran, Saudi Arabia. The study sample consisted of 28 children with hearing impairments (mean age = 12.6 years), divided into an experimental group (14) and a control group (14). The researchers used the Self-Awareness Scale for Children and Adolescents, the Self-Regulation Scale, and the Attention Difficulties Scale. The self-awareness training programme was implemented in 16 sessions over two months, followed by a three-month follow-up period. The results indicated statistically significant improvements in self-awareness, self-regulation, and attention in the experimental group during both post-testing and follow-up. The findings also demonstrated strong effects of the self-awareness-based intervention on these variables among children with hearing impairments who experience difficulties in self-regulation and attention.

P. Makmee's [44] study sought to assess the effects of mindfulness training on attention and working memory among elementary school students. A pretest-posttest design with two groups was used. The experimental group received an audio-visual mindfulness training programme for four weeks, with three sessions per week, each lasting 30 minutes, while the control group received no training. The sample included 60 elementary students from Thailand, divided equally between the two groups. The Continuous Performance Test (to measure attention using a computer screen) and the dual N-back task (to assess working memory) were used. The results showed that the experimental group achieved significantly higher accuracy scores in attention and working memory after the training compared to the control group. Additionally, response times for working memory tasks were significantly faster in the experimental group after the mindfulness training.

O. Bokk and B. Forster [45] evaluated the impact of brief mindfulness training on attention using the event-related potential (ERP) P300 response – a neural

marker of attention – in a sample of mindfulness-inexperienced participants. The researchers used tactile stimuli to examine attention shifts: repeated stimuli were applied to the index fingertip, and non-repeated stimuli were applied to the base of the index and little fingers on the right hand to evoke somatosensory P300. The mindfulness audio training programme was delivered to 22 participants for 10 minutes, while a control group of 22 participants listened to an audio recording unrelated to mindfulness. Results showed a reduction in somatosensory P300 amplitudes in response to non-repeated stimuli in post-tests compared to pre-tests, suggesting that even short mindfulness training improved attention among participants.

Y. Li, N. Yang, Y. Zhang et al. [46] explored the relationships between mindfulness, attention, and working memory, as well as performance differences between students with high mindfulness and those with low levels of attention and working memory under different stress conditions. The sample included 216 elementary school students. The Five Facet Mindfulness Questionnaire (FFMQ) was used, and their attention and working memory were tested under non-stress conditions. The results showed that attention partially mediated the relationship between mindfulness and working memory. The study concluded that mindfulness has a protective effect against stress-related declines in attention and working memory in elementary school students. Mindfulness was found to be a crucial psychological trait that influences attention and working memory, serving as an essential psychological resource for coping with the effects of stress on cognitive functions.

Methods

To achieve the goals of the current study, a mixed-methods approach was employed, combining an experimental method using a Repeated Measures Design (pretest, midtest, and posttest) with both experimental and control groups. This method allows for the investigation of causal relationships between the independent variable (intervention) and the dependent variables (test outcomes). The inclusion of both experimental and control groups helps control external influences and ensure the reliability of results. Repeated measures on the same participants across three time points enable assessment of the intervention's impact over time and comparison of differences between the groups.

Additionally, qualitative methods were used by conducting in-depth interviews with the participating students after implementing the training programme, to explore their perceptions of the programme and its impact on improving their attention control.

Study Population

The study population consisted of all twice-exceptional female students at the middle school level from the population of gifted students in the cities of Mecca, Jeddah, and Taif, as shown in Table 1. These students were identified as gifted while also exhibiting symptoms of ADHD. Due to technical, administrative, and time-related challenges, a comprehensive survey of the entire gifted student population to extract a subgroup of twice-exceptional students (gifted with ADHD) was not fea-

sible. Therefore, this study was limited to selected samples used for validating the reliability and validity of the study instruments and for the experimental phase.

Table 1

Population of gifted female Students in the Cities of Mecca, Jeddah, and Taif

City	Mecca	Jeddah	Taif	Total
No. of gifted students	826	1921	498	3245

Study Sample

The students were identified as gifted according to the identification system approved in Saudi Arabia by the King Abdulaziz and His Companions Foundation for Giftedness and Creativity (Mawhiba). The researchers then verified the presence of ADHD symptoms among the gifted students, thus classifying them as twice-exceptional. A step-by-step process was followed to obtain samples that align with the study objectives. A total of 450 gifted students were reached via purposive sampling, and ADHD symptom screening tools were applied to identify the final study samples. The screening stages and results are detailed in Table 2.

After the multi-stage screening of the 450 gifted students, a pilot sample of 30 twice-exceptional students was selected to apply the main study tools (executive attention scale and structured interview) and test their validity and reliability. Table 2 demonstrates the distribution of the pilot sample by screening stage and geographic region.

Table 2

Distribution of the pilot sample by screening stage and geographic regions

Stage	Procedure	Mecca	Jeddah	Taif	Total
1st	Application of the ADHD Rating Scale for Adolescents (School and Home Forms) to all public and private schools	826	1921	498	3245
2nd	Receiving and processing complete responses for statistical analysis	148	190	112	450
3rd	Selection based on raw scores (⩾19 in hyperactivity/inattention dimensions, ⩾35 total in school form; ⩾17 and ⩾34 respectively in home form)	18	27	13	62
4th	Collection and analysis of students' activities and work	18	27	13	62
5th	Interviews with students passing previous stages using DIVA ADHD Diagnostic Interview	18	27	13	62
6th	Inclusion of students scoring an average of ⩾6 in hyperactivity and inattention dimensions	16	26	12	54
7th	Final list sorted by scores of twice-exceptional students	16	26	12	54
Final twice-exceptional sample		16	26	12	54

The main sample consisted of 24 twice-exceptional female students (gifted and diagnosed with ADHD symptoms) selected randomly from the subgroup identified in the previous stages. They were randomly assigned to either the mindfulness-based intervention group (experimental) or the control group (no intervention). Their geographic distribution is demonstrated in Table 3.

Table 3

Geographic distribution of the main study sample (n = 24)

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

Study Instruments

The current study included three sections of instruments. The first section comprised tools for assessing Attention-Deficit/Hyperactivity Disorder (ADHD) in adolescents, namely the *ADHD Rating Scale-School and Home Versions* developed by G. J. DuPaul, T. J. Power, A. D. Anastopoulos et al. [47] and the DIVA diagnostic scale. The second section included the *Executive Attention Scale*, while the third contained the *mindfulness-based cognitive intervention programme*. All the instruments used in this study have been widely employed in educational and psychological research and are known for their high reliability and validity. The following is a detailed presentation of each:

Diagnostic Tools

A. Saudi Version of the ADHD Rating Scale for Adolescents (School and Home Forms)

This scale was adapted from G. J. DuPaul, T. J. Power and A. D. Anastopoulos et al. [47]. The scale was developed based on the DSM-5 diagnostic criteria for ADHD. Each version of the scale has two forms: one for children aged 5–10 and another for adolescents aged 11–17 [47]. The Saudi norms derived by A. H. Alhossein, S. F. Bukhit and J. I. Aljunaydil [48] were used to diagnose ADHD symptoms among the students. Table 4 presents the percentile criteria for females aged 14–16 in the inattention, hyperactivity, and total score domains. The raw score corresponding to the 93rd and 98th percentiles indicates the presence of ADHD symptoms.

Criteria for identifying ADHD symptoms

- School Form:
  - Raw score ⩾ 20 in the inattention subscale → inattention symptoms present.
  - Raw score ⩾ 19 in the hyperactivity subscale → hyperactivity symptoms present.
  - Raw score ⩾ 35 in the total score → ADHD present.
- Home Form:

- Raw score ⩾ 18 in the inattention subscale → inattention symptoms present.
- Raw score ⩾ 18 in the hyperactivity subscale → hyperactivity symptoms present.
- Raw score ⩾ 34 in the total score → ADHD present.

Table 4

Percentile Criteria for the Saudi Version of the ADHD Rating Scale (Home and School Forms) for Females Aged 14–16

Home Form			**School Form**		
Scale Dimension	Percentile 93	Percentile 98	Scale Dimension	Percentile 93	Percentile 98
Inattention	18	22.64	Inattention	20	24
Hyperactivity	17.24	20.64	Hyperactivity	19	22.38
Total Score	34	39	Total Score	34.83	43.76

Validity and Reliability

The original scale's validity and reliability were confirmed through factor analysis, internal consistency, test-retest reliability, inter-rater agreement, and criterion-related validity. Normative data aligned with DSM standards were provided for both forms (school and home). The Saudi version underwent the same rigorous statistical procedures, confirming its validity and reliability [48].

B. DIVA (Diagnostic Interview for ADHD in Adults)

DIVA is a semi-structured diagnostic interview designed to assess ADHD in both children and adults, based on DSM-5 criteria [49]. It addresses all 18 core symptoms across childhood and adulthood, focusing on symptom persistence and life impact. The interview includes practical, easy-to-understand examples for each symptom and covers five life domains: work/education, family/social relationships, leisure/hobbies, and self-image/self-esteem. The Arabic version was used in this study.

Executive Attention Tests

Executive attention control can be assessed using several tasks requiring individual performance. These tasks have been computerised to facilitate response and improve scoring accuracy.

A. Stroop Colour and Word Test

The Stroop Task evaluates selective attention and cognitive control by asking participants to name the colour of a word while ignoring its meaning (e.g. the word "Red" printed in blue ink). Slower response times on incongruent trials reflect Stroop interference, indicating difficulty in suppressing automatic responses [50]. The study followed the procedure of L. Bustamante, F. Lieder, S. Musslick et al. [51] to develop test items. The test consisted of two parts. The first part included 10 incongruent trials (colour and word mismatch). Participants were shown a target stimulus in the centre of the screen followed by answer options that included words

printed in different colours. The participant's task was to match the colour of the target stimulus, not its meaning, with one of the response options.

If the target is the word "Red" displayed in red ink, and one option is the word "Blue" written in red ink, the participant must select "Blue" because its ink colour (red) matches the target's ink colour – regardless of the word meaning (Figure 2).

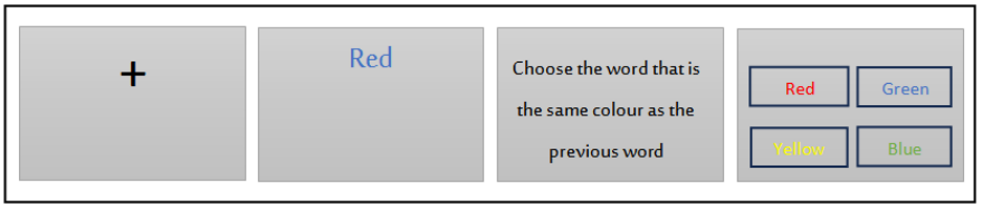

Fig. 2. Example of Stroop Test items (incongruent condition)

The second part includes 10 congruent items, where the colour of the word matches its meaning (congruent). The participant is asked to select the response option that matches the colour of the word with the colour of the target stimulus, as shown in Figure 3. Correct responses and reaction times are measured in milliseconds.

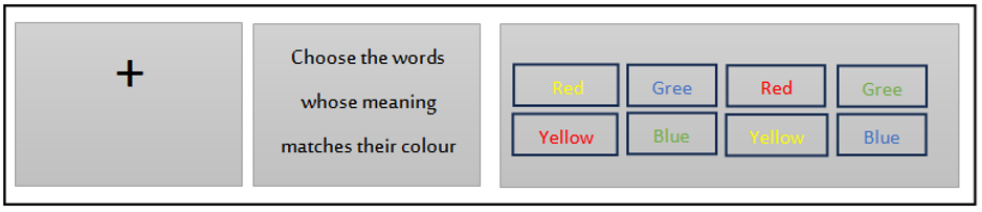

Fig. 3. Example of Stroop Test items (congruent condition)

B. Flanker Task by B. A. Eriksen and C. W. Eriksen [52]

The Flanker Task assesses focused attention and interference control. The test consists of two parts: the first part includes 10 congruent items where a target stimulus and two response options are displayed [52]. Both the target and response stimuli are distractor elements made up of five arrows pointing in the same direction (>> > >>). The participant's task is to identify the direction of the central (middle) arrow only by pressing the right button if the arrow points right and the left button if the arrow points left, as shown in Figure 4.

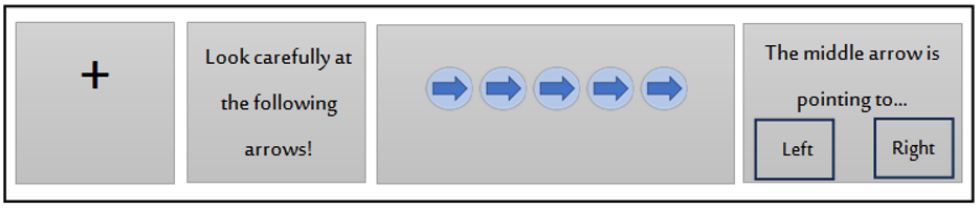

Fig. 4. Example of Flanker Test (congruent condition)

The second part includes 10 incongruent items, where a target stimulus and two response options are shown. Both the target and response stimuli are distractor elements consisting of five arrows pointing in different directions (>> < >>). The participant's task is to determine the direction of the central arrow only by pressing the right button if the arrow points right and the left button if the arrow points left, as shown in Figure 5.

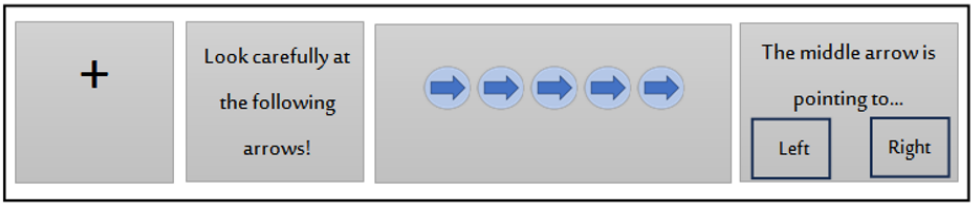

Fig. 5. Example of Flanker Test (incongruent condition)

Correct responses and reaction times are recorded in milliseconds. Slower responses in incongruent trials reflect Flanker interference [51]. This task activates the fronto-parietal network, linking it to executive attention [52].

Correct responses and reaction times are measured in milliseconds. Slower responses in incongruent trials reflect Flanker interference [52]. This task activates the fronto-parietal network, linking it to executive attention [53].

C. Simon Task by J. R. Simon and J. D. Wolf [54]

This test consists of 15 items with increasing difficulty (reaction time decreases as the test progresses). Participants are presented with a target stimulus and two response options. The target stimulus is the word "Right" or "Left", and the response options are buttons on the right and left sides. The participant's task is to select the response corresponding to the *meaning* of the word, regardless of its position on the screen. For example, if the stimulus word is "Right", the participant should press the right-hand button, as shown in Figure 6. To increase difficulty, the stimulus word may appear on either side of the screen. Thus, the challenge for participants is to attend to the meaning of the word while ignoring its on-screen location. Correct responses and reaction times are recorded in milliseconds.

The Simon Task assesses spatial conflict resolution, requiring participants to respond to a non-spatial feature (e.g. colour) of a stimulus presented on either the left or right side. Slower responses occur when the stimulus location does not match the response side (e.g. a blue circle on the right requiring a left-hand response), a phenomenon known as the *Simon Effect*. Correct responses and response times are recorded in milliseconds.

Fig. 6. Example of the Simon Task

D. Sustained Attention to Cue Task by C. Draheim, J. S. Tsukahara, J. D. Martin et al. [55]

The Sustained Attention to Cue Task (SACT) measures sustained attention by asking participants to monitor a series of cues (e.g. arrows) and respond only to rare targets. It assesses vigilance decline over time [55]. Task procedure:

1. Each trial begins with a central fixation cross (+) displayed in the middle of the screen for one second, followed by a 750-millisecond interval displaying the phrase "Get ready!" at the location where the cue will appear, along with an auditory alert.
2. A circular cue then appears for approximately 500 milliseconds and is subsequently removed during a waiting interval.
3. The waiting period lasts either 0 seconds or between 2 and 12 seconds in 500-millisecond increments (e.g. 2, 2.5, 3, 3.5 … seconds), varying in each trial.
4. After the variable waiting interval, a set of letters in a cloud-like formation appears at the indicated location for 250 milliseconds. The target letter is the central one, shown in slightly darker font colour, as illustrated in Figure 7. Performance is assessed based on the percentage of correct responses and reaction times.

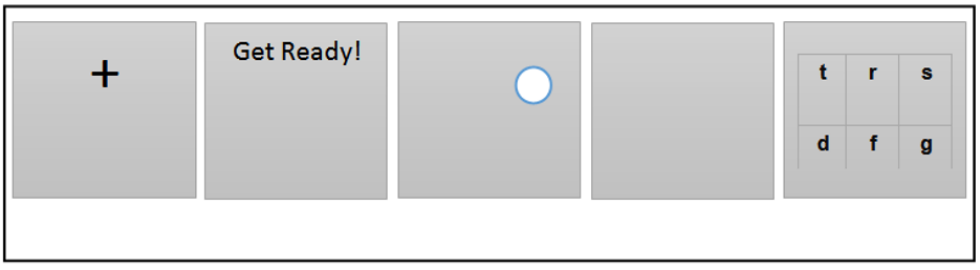

Fig. 7. Example of the Sustained Attention to Cue Task (SACT)

Construct Validity of the Test

The approach of C. Draheim, J. S. Tsukahara, J. D. Martin et al. [55] was followed to assess the validity of attention tests by calculating the correlation coefficients among the total scores of the tests, as shown in Table 5. Table 5 indicates that all correlation coefficients were statistically significant at the level ($\alpha \leqslant 0.05$), which confirms the construct validity of the scale and thus supports its reliability for measuring attention in twice-exceptional students.

Table 5

Correlation coefficients among attention tests (n = 30)

Test	Sustained attention
Simon	.283*
Flanker	.275*
Stroop	.268*

Test Reliability

Similarly, the reliability of the attention tests was assessed by calculating the average internal consistency coefficients for each test, following the method of C. Draheim, J. S. Tsukahara, J. D. Martin et al. [55], as shown in Table 6. The table shows that all correlation coefficients were statistically significant and appropriate for the purposes of the current study.

Table 6

Internal consistency coefficients of attention tests (n = 30)

Test	Average internal consistency
Simon	.81
Flanker	.78
Stroop	.74
Sustained Attention	.71

The Mindfulness-Based Intervention Programme

General Objectives of the Programme:

1. To enhance executive attention skills in twice-exceptional middle school girls using cognitive interventions (intellectual stimulation and mindfulness).
2. To improve emotional and social aspects among twice-exceptional middle school girls.

Specific Objectives of the Programme

Derived from the general objectives, the specific aims are to enhance the efficiency of executive attention in gifted middle school girls with ADHD through improvement in the following skills: emotion perception, awareness of thoughts and mindful observation, focused and sustained attention, monitoring and describing, judgment formation, mindful thinking, mindful action, orientation to the present, openness to new experiences, and self-motivation.

Core Elements in Programme Design

The programme was built around the following core components:

1. Defining General and Specific Objectives:

- General: outlining the broad vision of the programme and its short- and long-term goals.

- Specific: setting measurable outcomes for each part, focusing on enhancing executive attention in twice-exceptional students.

2. Needs Assessment:
- Evaluating each student's individual needs based on their personal profile and identifying strengths and areas for growth.

3. Designing Training Activities:
- Developing diverse activities to improve specific skills such as critical thinking, creativity, and social-emotional competencies.

4. Content Development:
- Creating age-appropriate and cognitively suitable materials tailored to students' capabilities.

5. Instructional Strategies:
- Using innovative methods such as project-based learning, cooperative learning, and design thinking.

6. Assessment and Monitoring:
- Designing multiple assessment tools to track student progress and identify strengths and weaknesses (e.g. self-evaluation, worksheets, performance reports).

7. Psychological and Emotional Support:
- Providing support to boost self-confidence and develop emotional intelligence, which helps manage stress and challenges.

8. Flexibility and Adaptability:
- Ensuring the programme can be adjusted to meet evolving student needs.

9. Interaction and Feedback:
- Offering opportunities for ongoing interaction and feedback between trainers and students to enhance learning and motivation.

10. Documentation and Final Evaluation:
- Recording all stages, activities, and evaluation results throughout the programme.

Programme Outcomes

- Improved Focus and Attention

Many twice-exceptional students struggle with attention. Mindfulness techniques help them stay on task, reduce distractions, and improve performance in academic and social settings.

- Self-Awareness Development

These students often have complex self-perceptions, feeling frustrated by challenges despite recognising their exceptional abilities. Mindfulness fosters self-awareness, helping them accept both strengths and growth areas without self-judgment.

- Reduced Anxiety and Stress

Many twice-exceptional students experience anxiety due to perfectionism and performance pressure. Relaxation, meditation, and stress-management techniques help them feel more stable and less anxious when facing challenges.

- Enhanced Social Skills

Some twice-exceptional students – especially those with autism or social anxiety – face social difficulties. Mindfulness training promotes empathy, active listening, and awareness of others, improving interpersonal relationships and communication.

- Improved Executive Functioning Skills

These students often face challenges in planning, organising, and monitoring tasks. Mindfulness helps them break tasks into manageable steps and stay present, leading to better decision-making and goal-setting.

Programme Implementation Procedures

The training programme consists of twenty-one training sessions, conducted at a rate of three sessions per week. A portion of the training programme is implemented at the Development and Training Centre of the Makkah Education Directorate, as it offers spacious and well-equipped training halls. The remaining parts of the programme are delivered at the students' schools.

Student-centred training methods were used to enhance interaction in the programme sessions and activities, including brainstorming, role-playing, discussions, and case studies. The programme targets twice-exceptional (2e) middle school female students – those who are identified as gifted yet also face sensory and cognitive challenges.

Various training materials were utilised, such as computers, data projectors, pens and papers, whiteboards, worksheets, video clips, websites, brochures, headphones, flashcards, and microphones. As for the programme's implementation timeline, it is scheduled to take place during the first semester of the 2024–2025 academic year, over a duration of 10 weeks, with sessions conducted three times per week. Each session lasts approximately 80 minutes and is integrated into the students' regular school schedule.

Programme Validity

To ensure the theoretical and practical structure and content of the programme, the Delphi method was employed to verify its validity. The programme was reviewed by a panel of experts in gifted education, creativity, and psychology, who were asked to provide comments and suggested modifications. Reviewers were instructed to evaluate the programme objectives, session content, alignment with the target group, and the appropriateness of the number of sessions.

Feedback from reviewers was taken into consideration, and the programme was finalised based on their input. A 90% agreement rate among reviewers was achieved regarding the appropriateness of the sessions and content.

Results

Results of the First Research Question

Null Hypothesis Related to the First Question

There are no statistically significant differences at the level ($\alpha \leqslant 0.05$) between the pre-, mid-, and post-test mean scores for executive attention control between the experimental group (which received the cognitive intervention programme) and the control group (which did not) among twice-exceptional middle school girls in public schools in Saudi Arabia.

To answer this question and test the hypothesis, means and standard deviations were calculated for the total scores of both the experimental and control groups on the pre-, mid-, and post-tests measuring executive attention control, as well as for the response time (in milliseconds), as shown in Table 7.

Table 7

Means and standard deviations of total scores for executive attention control and response time (ms)

Group	Measurement	Mean	Std. Dev.	Min	Max
Experimental	Pre-test	2883.333	10.063	2862.464	2904.203
	Mid-test	2725.000	10.032	2704.196	2745.804
	Post-test	2528.333	12.101	2503.237	2553.429
Control	Pre-test	2886.667	10.063	2865.797	2907.536
	Mid-test	2876.667	10.032	2855.863	2897.471
	Post-test	2890.833	12.101	2865.737	2915.929

Table 7 reveals apparent differences between the experimental and control groups in the pre-test. The mean scores were 2883.333 for the experimental group and 2886.667 for the control group, with a slight difference of 3.334, which indicates that the two groups were relatively equivalent before the intervention. In the mid-test, the control group scored a mean of 2876.667, while the experimental group scored 2725.000 – a difference of 151.667 in favour of the control group. In the post-test, the control group's mean was 2890.833, compared to 2528.333 for the experimental group, showing a substantial difference of 362.5 in favour of the control group. Compared to the minor pre-test difference (3.334), the post-test results indicate a significant increase in the gap, as illustrated in Figure 8.

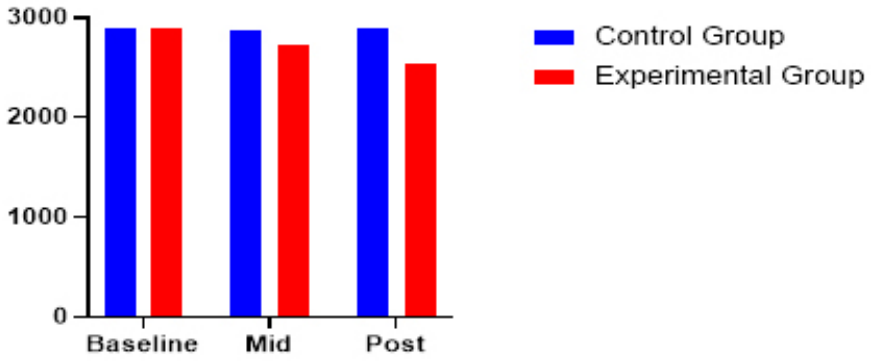

Fig. 8. The averages of the experimental and control groups for attention control according to the measurement times

To verify the presence of a statistically significant difference at the level ($\alpha \leqslant 0.05$) between the control and experimental groups on the pretest, midtest, and posttest measurements of attention control efficiency and the time taken to respond to those tests, a Multivariate Analysis of Variance (Multivariate Tests) was used to isolate the difference between the two groups' scores at the pretest. The results are demonstrated in Table 8.

Table 8

Multivariate Analysis of Variance Test for Differences between the control and experimental groups on pretest, midtest, and posttest measurements of attention control efficiency and response time to those tests

Source of variance	Effect	Value	F Value	Degrees of freedom	Standard error	Statistical significance	Eta Squared (η^2)
Response time	Pillai	0.997	4041.161b	2.000	21.000	0.000	0.997
	Wilks Lambda	0.003	4041.161b	2.000	21.000	0.000	0.997
	Hotelling's	384.873	4041.161b	2.000	21.000	0.000	0.997
	Roy's Root	384.873	4041.161b	2.000	21.000	0.000	0.997
Response time * group	Pillai	0.997	3636.587b	2.000	21.000	0.000	0.997
	Wilks Lambda	0.003	3636.587b	2.000	21.000	0.000	0.997
	Hotelling's	346.342	3636.587b	2.000	21.000	0.000	0.997
	Roy's Root	346.342	3636.587b	2.000	21.000	0.000	0.997

It is noted from the above table that there are statistically significant differences between the control and experimental groups in the pretest, midtest, and posttest measurements of attention control efficiency and the response time to those tests. The significance value reached 0.000, which is less than 0.05, indicating a significant interaction between the groups (experimental and control) and time (pretest, midtest, and posttest measurements). This confirms that the effect of the cognitive intervention programme differs across the different measurement time points.

It is worth noting that the above 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 pretest, midtest, and posttest measurements of attention control efficiency between the experimental group, which underwent the cognitive interventions programme, and the control group, which did not, among twice-exceptional middle school female students in public schools in Saudi Arabia.

Similarly, the value of Eta squared (η^2) reached 0.997, indicating that this interaction explains a large proportion of the variance in attention control scores between the two groups. That is, about 99.7% of the improvement in attention control efficiency in the posttest of the experimental group is attributed to the cognitive intervention programme provided to the experimental group.

To determine the direction of differences according to group, Pairwise Comparisons were used for attention control efficiency between individuals in the control and experimental groups, as shown in Table 9.

Table 9

Post Hoc Pairwise Comparisons for attention control efficiency between individuals in the control and experimental groups

Group	Group	Mean difference	Standard error	Statistical significance
Experimental	Control	-172.500*	14.979	0.000
Control	Experimental	172.500*	14.979	0.000

It is noted from the above table that the differences between the control and experimental groups in attention control efficiency are statistically significant in favour of the experimental group that received the cognitive interventions programme.

To determine the direction of differences according to response time on attention control measures, Pairwise Comparisons were used for the three measurements of the experimental group (pretest, midtest, and posttest), as shown in Table 10.

Table 10

Post Hoc Pairwise Comparisons of total scores of the experimental group on the three measurements: pretest, midtest, and posttest

Measurement	Measurement	Mean Difference	Standard Error	Statistical Significance
Pretest	Midtest	84.167*	1.205	0.000
	Posttest	175.417*	2.750	0.000
Midtest	Pretest	-84.167*	1.205	0.000
	Posttest	91.250*	2.938	0.000
Posttest	Pretest	-175.417*	2.750	0.000
	Midtest	-91.250*	2.938	0.000

It is noted from the above table that the differences between the three measurements were statistically significant. The mean difference between the pretest and midtest measurements (84.167) favoured the pretest, the mean difference between the pretest and posttest measurements (175.417) favoured the pretest, and similarly, the mean difference between the midtest and posttest measurements (91.250) favoured the midtest. This means that the response time on the attention control measures decreased across the different measurement time points.

Therefore, it can be said that the reduction in response time can be attributed to the cognitive interventions programme provided to the experimental group, which confirms the effectiveness of the training programme in improving attention control efficiency for twice-exceptional middle school female students in public schools in Saudi Arabia.

Results Related to the Second Research Question

To answer the qualitative question of the study, data were collected from interviews with the twelve female students who participated in the training programme. These interviews included their opinions about their experiences with the mindfulness programme. Thematic analysis was used to analyse the students' responses by coding these responses according to recurring themes related to the training programme. The qualitative data analysis software NVivo was used to identify recurring patterns in the students' responses. The aim of the analysis was to identify the main themes related to the perceived effectiveness of the programme, its impact on cognitive functions (executive attention), and aspects for improvement from the perspectives of the participating students. The analysis revealed several main themes: general positive acceptance and increased self-awareness, enhancement of cognitive skills, programme components and learning methods, and suggestions and recommendations for programme development.

Overall, the students reported a positive experience with the programme. Many of them indicated noticeable improvements in their attention control as well as acquiring new perspectives on their thoughts and feelings. Most students perceived positive effects on their executive attention after participating in the training programme. All participating students reported significant improvements in concentration and attention control. They described their ability to focus despite distractions, to refocus more quickly after losing attention, to control impulsivity, and to maintain attention while performing multitasking activities such as reading or doing homework. They mentioned some examples of activities related to this, such as resisting mind-wandering, acting with focused impulse, concentrating during reading, discussing mistakes and learning from them, and attention exercises included in the training programme in general.

Main Themes and Their Frequency

Table 11 shows the main themes identified by classifying students' responses into nodes in the NVivo program. It can be observed that the themes of improved concentration and attention and the positive impact of the programme on executive attention received the most attention from the students. In contrast, artistic activities such as drawing received less attention.

Table 11

Main themes identified through categorisation of students' responses

Main theme	Number of students mentioning it	Examples of responses
Improved emotional awareness	10	"I began to understand how my feelings affect my reactions".
Improved concentration and attention	12	"I became able to focus in class despite the noise".
Artistic activities (e.g. drawing)	5	"Expressing feelings through art helped me understand myself".
Suggestions (e.g. additional sessions)	8	"I suggested adding sessions on anxiety control during exams".

Relationships between Themes

Relationships between sub-themes were identified using matrix coding queries in the analysis. Table 12 indicates that breathing exercises combined with executive attention were frequently mentioned in students' responses, whereas the use of art for expression was less frequent.

Table 12

Relationships among sub-themes using cross-query analysis

Sub-theme	Executive attention	Suggestions
Breathing exercises	10	-
Stop-and-think activities	9	3
Group activities	-	6
Use of art for expression	1	-

Most Impactful Sessions and Activities

Table 13 demonstrates the sessions and activities that received the greatest interest from the students. It is noted that the "Emotional Awareness" session received the highest attention, while artistic activities ranked last.

Table 13

Sessions and activities that attracted students' interest

Session/Activity	Number of students mentioning it	Reason for preference
Emotional awareness	7	"It helped me understand how emotions affect behaviour".
Mindful thinking	6	"It taught me to change negative thinking".
Stop-and-think activity	5	"It helped improve memory and concentration".
Artistic activities (drawing)	4	"It allowed me to express my feelings without words".

Preferred Training Methods

Table 14 shows the training methods preferred by the students. The most preferred method was hands-on application, while group projects ranked lowest.

Table 14

Preferred training methods among the students

Training method	Number of students choosing it
Hands-on application	11
Practice-based training	8
Role-playing	5
Discussions	5
Case studies	3
Group projects	2

Challenges, Suggestions, and Recommendations

Suggestions were categorised using tree node coding. The most prominent suggestions from students included adding topics and activities such as anxiety control during exams and balancing study with hobbies. They also suggested improving activities by adding educational electronic games and outdoor physical activities. Regarding training methods, they proposed increasing group activities and using short videos in training. Concerning challenges and problems faced during training, students mentioned some difficulties such as insufficient time for some activities and difficulty commuting to the training location from their perspective.

Discussions

The training programme contributed to improving executive functions by modifying cognitive strategies and achieving a noticeable interaction over time. This led to enhanced quality and speed in attention performance. This result underscores the necessity of adopting such programmes in educational settings to enhance cognitive performance among students with special needs and to maximise the benefits of their unique cognitive abilities.

Since executive attention is considered a set of cognitive processes that include controlling distraction, filtering relevant from irrelevant information, and organising timely responses, we can say that the cognitive intervention programme helped reinforce these processes. It did so by training twice-exceptional students to use effective organisational strategies, resulting in improved task-switching abilities and a greater focus on essential information during tests. The students were able to adopt systematic approaches to reduce distraction and increase the efficiency of directing attention, which positively reflected on their overall executive attention performance.

As for the progressive development across the pre-, mid-, and post-intervention time points, it confirmed the cumulative effect of the intervention. The differences between these measurements showed that improvement in executive attention efficiency was not due to a sudden change, but rather a gradual result of cognitive interventions. In the pre-test, executive abilities were less apparent; improvements began to emerge in the mid-test and became more pronounced in the post-test. This indicates that the training programme had a growing impact over time.

The statistically significant interaction between the experimental and control groups and the time factor suggests that the observed improvement in performance was not merely a momentary difference, but a result of continuous interaction between the training intervention and the natural development of executive abilities over time. This indicates that the programme changed the dynamics of executive attention in alignment with the students' developmental progress during the programme, resulting in improved cognitive processing speed.

Notably, the improvement in response time serves as practical evidence of the programme positive impact. Reduced response time indicates better activation of neural control and regulation mechanisms, which in turn is likely to enhance academic performance by making cognitive processes smoother and more efficient.

Additionally, the repeated and intensive training sessions gave students the opportunity to consolidate the new strategies and turn them into automatic habits. This repeated practice contributed to improving the quality and efficiency of executive attention, as well as reducing response time – emphasising the sustained effectiveness of the interventions over time.

Importance of Specialised Training Programmes

These findings highlight the importance of specialised training programmes. The previous results confirmed that cognitive interventions specifically designed to meet the needs of twice-exceptional students can lead to significant improvements in executive performance. This supports the implementation of such programmes in general education schools to enhance cognitive capacities in this group.

Given the observable time-based interaction with the intervention effect, it is crucial to continue evaluating and updating training programmes, while monitoring improvement over extended periods to ensure sustainability and adaptability to the cognitive development of the students.

Alignment with Previous Studies

Our findings are consistent with studies conducted by E. Hammerdahl, L. M. Hilt, A. Draheim et al. [41], B. M. Nesrine, S. Jarraya and L. Caprioli [42], M. A. Hammad and H. A. B. Shalhoub [43], P. Makmee [44], O. Bokk and B. Forster [45], and Y. Li, N. Yang, Y. Zhang et al. [46], which demonstrated that mindfulness training improves executive attention in experimental groups compared to control groups. They also showed a significant decrease in ADHD symptoms among participants.

Interpretation of Qualitative Results

The qualitative results can be explained by the effectiveness of the exercises and activities used in the programme, such as "stop and think" and "conscious breath-

ing," which enhance sustained attention. This aligns with A. Lutz, H. A. Slagter, J. D. Dunne et al. [49], who found that mindfulness practices improve performance in cognitive tasks. Additionally, group activities were associated with improved social interaction, a factor that enhances intrinsic motivation according to E. L. Deci and R. M. Ryan's Self-Determination Theory [50].

Emotional Awareness and Academic Anxiety

Regarding the understanding of how emotions affect daily behaviours, studies suggest that mindfulness training boosts emotional awareness and facilitates emotional regulation. This highlights the role of creative activities in enhancing non-verbal emotional expression. On the other hand, students emphasised the need for additional sessions to address academic anxiety and balance between life and study. Academic pressure is a major barrier to student performance, and mindfulness-based interventions reduce anxiety and enhance psychological flexibility.

Some students also proposed using technology (e.g. educational games) in training. This aligns with research on integrating digital media in education to increase engagement such as P. Sahu, V. K. Chattu, A. Rewatkar et al. [56], G. J. Hwang, L. Y. Chiu and C. H. Chen [57], S. G. Hofmann, A. T. Sawyer, A. A. Witt et al. [58], and J. Kabat-Zinn [59].

Conclusions and Recommendations

Our results revealed statistically significant differences in attention control efficiency among the pre-, mid-, and post-measurements between the experimental group, which received the cognitive intervention programme, and the control group, which did not. Multivariate Tests confirmed that these differences were not merely superficial but substantial and statistically significant at the alpha level ($\alpha \leqslant 0.05$), with a p-value of 0.000 – below the threshold – thus necessitating the rejection of the null hypothesis that denies differences between the two groups and supporting the existence of a real effect of the training programme.

The mean performance scores across the three measurement points (pre, mid, and post) indicated a progressive improvement in the experimental group, whereas the control group's performance remained almost unchanged or improved slightly in a manner not attributable to any intervention. The response time of the experimental group decreased from 2883.33 in the pre-measurement to 2725.00 in the mid-measurement, and further to 2528.33 in the post-measurement, reflecting a gradual enhancement in attention control efficiency. In contrast, the control group showed no substantial change.

Moreover, pairwise comparison analysis confirmed that the differences between the three measurements within the experimental group were all statistically significant, underscoring the programme sustained effectiveness over time. The very high eta squared value ($\eta^2 = 0.997$) indicates a large effect size, suggesting that 99.7% of the observed improvement in performance can be attributed to the training programme, with minimal likelihood that other factors influenced the outcome.

The findings of the qualitative question further reinforced the quantitative results. The students who participated in the individual interviews expressed positive perceptions of the programme, noting significant improvement in their attention control, increased self-awareness, and better ability to refocus after distraction. Thematic analysis of their responses using NVivo revealed that the most frequently mentioned themes included enhanced concentration and attention, improved emotional awareness, and suggestions for programme improvement – such as adding sessions on test anxiety management and incorporating stimulating digital or physical activities.

Among the programme components that received the most positive engagement were mindful breathing exercises and "stop and think" activities, which helped the students acquire practical cognitive skills to manage their attention. Most participants preferred training methods based on hands-on application and practice over theoretical or group-based approaches, highlighting the importance of designing educational programmes rooted in experiential and active learning – particularly for exceptional learners.

Based on our findings, we recommend developing training programmes based on mindfulness strategies to enhance cognitive abilities, academic achievement, and creative thinking in twice-exceptional students and utilise cognitive load theory in designing educational interventions tailored for twice-exceptional students.

We also recommend assessing the impact of mindfulness on critical and creative thinking in twice-exceptional students by evaluating how cognitive interventions influence the development of these thinking skills to support academic and personal growth and evaluate the effect of cognitive interventions on social and emotional skills and examine the relationship between cognitive improvement and social development in twice-exceptional students. This would support the development of comprehensive programmes that foster their holistic growth.

References

1. Alazzam A.A., Al-Shokran A.A., Suleiman B.M., Rababah M.A., Al-Hawamdeh B.M., Al-Marazik I.A., Tanjour I., Al-Habis F.A. The relationship between psychological distress and mindfulness among exceptional students in the main stage of schooling. *Obrazovanie i nauka = The Education and Science Journal*. 2024;26(4):148–168. doi:10.17853/1994-5639-2024-4-148-168
2. Rababa'h S.Y., Rababah L.M., Rababah M.A., Bany Hani M.G., Alorani O.I., Al-Habies F.A. Teachers' perceptions of the barriers of employing educational technology skills in teaching. *Obrazovanie i nauka = The Education and Science Journal*. 2024;26(9):74–97. doi:10.17853/1994-5639-2024-9-74-97
3. Abu Omar R.A., Alhasanat H.A., Rababa'h S.Y., Rahamneh K.F., Kaddum M., Al-Thunebat S.A., Rababah M.A. Jordanian Arabic language teachers' attitudes towards the use of differentiated instruction in teaching. *Journal of Language Teaching and Research*. 2025;16(2):425–434. doi:10.17507/jltr.1602.08
4. Donaldson S.I., Lee J.Y., Donaldson S.I. The effectiveness of positive psychology interventions in the workplace: a theory-driven evaluation approach. In: Van Zyl L., Rothmann Sr. S., eds. *Theoretical Approaches to Multi-Cultural Positive Psychological Interventions*. Cham: Springer; 2019:115–159. doi:10.1007/978-3-030-20583-6_6

5. Alotaibi B.M., Alrashidi S.A., Bahrawi A.A. Impact of mindfulness-based strategy training on working memory in twice-exceptional students in Saudi Arabia. *Obrazovanie i nauka = The Education and Science Journal*. 2025;27(9). doi:10.17853/1994-5639-2025-4330
6. Alghazo K.M., Qbeita A.A.A., Rababah M.A., Malkawi N.A. English language teachers' employment of successful intelligence skills. *International Journal of English Language and Literature Studies*. 2023;12(2):184–194. doi:10.55493/5019.v12i2.4839
7. Rababah L.M., Rababah M.A. Online social learning and instructional presence: enhancing English education at a Jordanian university. *Forum for Linguistic Studies*. 2024;6(6):729–741. doi:10.30564/fls.v6i6.7430
8. Salah B.M., Alhamad N.F., Alazzam A.A., Albadarneh M.M., Alqiam H.A.A., Rababah M.A. Optimism predictive ability and psychological flexibility among students during COVID-19 pandemic. *Journal of Educational and Social Research*. 2022;12(5):197–208. Accessed July 05, 2025. https://creativecommons.org/licenses/by-nc/4.0/
9. Wolor C.W., Madli F., Rababah M.A., Mukhibad H., Hoo W.C. Examining the impact of knowledge management use and innovation on business performance of MSMEs in the digital age. Case study MSMEs in Indonesia. *Journal of Sustainability Research*. 2024;4(1):1–18. doi:10.20900/jsr20240070
10. Sakarneh M.A., Ziadat A.H., Almakaleh A.A., Rababah M.A., Alhassan A.H., Al-Muhairat L.A., Al-Rababah H.A. Socio-pedagogical competencies needed by educators of students with autism spectrum disorder: a parent's perspective. *Obrazovanie i nauka = The Education and Science Journal*. 2022;25(5):176–194. doi:10.17853/1994-5639-2023-5-176-194
11. Almsbhieen M.M., Aljazi S.F.F., Alhasanat H.A.A., Rababah M.A. The effect of active learning strategies on developing oral reading skills in low-achieving native-speaker Arabic students. *International Journal of English Language and Literature Studies*. 2023;12(4):384–400. Accessed July 05, 2025. https://ideas.repec.org/a/asi/ijells/v12y2023i4p384-400id4923.html
12. Alorani O.I., Erkir S., Rababa'h S.Y., Bani-Khair B.M., Alkhaldi A.A., Rababah MA, et al. English language teachers' perspectives on technological applications used for students with disabilities. *Journal of Language Teaching and Research*. 2025;16(1):168–179. doi:10.17507/jltr.1601.18
13. Alorani O.I., Rababah S.Y., Al-Maraziq I., Miqdadi Z.M., Al-Habies F., Rababah M. Social media addiction and its relationship with feelings of alienation and cognitive distortions among youth in Jordan. *Obrazovanie i nauka = The Education and Science Journal*. 2025;27(6):126–148. doi:10.17853/1994-5639-2025-6-126-148
14. Bani Yassien B, Melhem M, Albadarneh M, Rababah M. Coping strategies with anger as a state and an emotional trait in female students. *Obrazovanie i nauka = The Education and Science Journal*. 2023;25(8):162–185. doi:10.17853/1994-5639-2023-8-162-185
15. Alazzam A.A., Alhamad N.F., Alhassan A.A., Rababah M.A. Psychological flow and academic self-efficacy in coping with online learning during COVID-19 pandemic. *Journal of Hunan University Natural Sciences*. 2021;48(11):1–11. Accessed July 05, 2025. http://jonuns.com/index.php/journal/article/view/847
16. de Vreeze-Westgeest M.G.J., Vogelaar B. Cognitive training in the domain of mathematics for potentially gifted children in primary school. *Education Science*. 2022;12(127):1–13. doi:10.3390/educsci12020127
17. Stevens C., Bavelier D. The role of selective attention on academic foundations: a cognitive neuroscience perspective. *Developmental Cognitive Neuroscience*. 2012;2(1):S30–48. doi:10.1016/j.dcn.2011.11.001
18. Luck S.J., Gold J.M. The construct of attention in schizophrenia. *Biological Psychiatry*. 2008;64(1):34–39. doi:10.1016/j.biopsych.2008.02.014

19. Sharp J.E., Jennings P.A. Strengthening teacher presence through mindfulness: what educators say about the Cultivating Awareness and Resilience in Education (CARE) Program. *Mindfulness*. 2015;7(1):209–218. doi:10.1007/s12671-015-0474-8
20. Van de Weijer-Bergsma E., Formsma A.R., de Bruin E.I., Bögels S.M. The effectiveness of mindfulness training on behavioral problems and attentional functioning in adolescents with ADHD. *Journal of Child and Family Studies*. 2012;21(5):775–787. Accessed July 05, 2025. https://link.springer.com/article/10.1007/s10826-011-9531-7
21. Moore A., Malinowski P. Meditation, mindfulness and cognitive flexibility. *Consciousness and Cognition*. 2009;18(1):176–186. doi:10.1016/j.concog.2008.12.008
22. Reis S.M., Baum S.M., Burke E. An operational definition of twice-exceptional learners: implications and applications. *Gift Child Quarterly*. 2014;58(3):217–230. doi:10.1177/0016986214534976
23. Conejeros-Solar M.L., Gómez-Arizaga M.P., Schader R.M., Baum S.M., Sandoval-Rodríguez K., Henríquez S.C. The other side of the coin: perceptions of twice-exceptional students by their close friends. *SAGE Open*. 2021;11(2):215824402110222. doi:10.1177/21582440211022234
24. Diéguez M.P., García M.C., Asencio E.N., Vergara-Moragues E. Executive function training through a mindfulness-based neuroeducational program in elementary school students. *Mindfulness*. 2024;15:2739–2749. doi:10.1007/s12671-024-02474-8
25. O'Sullivan M., Robb N., Howell S., Marshall K., Goodman L. Designing inclusive learning for twice exceptional students in Minecraft. *International Journal of e-Learning and Distance Education*. 2017;32. Accessed July 05, 2025. https://www.ijede.ca/index.php/jde/article/view/1043
26. Miyake A., Friedman N.P., Emerson M.J., Witzki A.H., Howerter A., Wager T.D. The unity and diversity of executive functions and their contributions to complex "Frontal Lobe" tasks: a latent variable analysis. *Cognitive Psychology*. 2000;41(1):49–100. doi:10.1006/cogp.1999.0734
27. Posner M.I., Rothbart M.K., Tang Y.Y. Enhancing attention through training. *Current Opinion in Behavioral Sciences*. 2015;4:1–5. doi:10.1016/j.cobeha.2014.12.008
28. Wolor C.W., Wibawa E.A., Eranza D.R.D., Nurkhin A., Rababah M.A. Impact of bullying on work motivation and job satisfaction. *Health Psychology Report*. 2024;11(1):1–12. doi:10.5114/hpr/166427
29. Burgoyne A.P., Mashburn C.A., Tsukahara J.S., Engle R.W. Attention control and process overlap theory: searching for cognitive processes underpinning the positive manifold. *Intelligence*. 2022;91:101629. doi:10.1016/j.intell.2022.101629
30. MacDonald H.Z., Olsen A. The role of attentional control in the relationship between mindfulness and anxiety. *Psychological Reports*. 2020;123(3):759–780. doi:10.1177/0033294119835756
31. Suárez-García Z., Álvarez-García D., García-Redondo P., Rodríguez C. The effect of a mindfulness-based intervention on attention, self-control, and aggressiveness in primary school pupils. *International Journal of Environmental Research and Public Health*. 2020;17(7). doi:10.3390/ijerph17072447
32. Oliva F., Malandrone F., di Girolamo G., Mirabella S., Colombi N., Carletto S., Ostacoli L. The efficacy of mindfulness-based interventions in attention-deficit/hyperactivity disorder beyond core symptoms: a systematic review, meta-analysis, and meta-regression. *Journal of Affective Disorders*. 2021;292:475–486. doi:10.1016/j.jad.2021.05.068
33. Cohen V. Common ground: the relational dimensions of mindfulness and psychotherapy. *The Humanistic Psychologist*. 2014;42(3):319–328. doi:10.1080/08873267.2014.912653
34. Chiesa A., Calati R., Serretti A. Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review*. 2011;31(3):449–464. doi:10.1016/j.cpr.2010.11.003
35. Kochanska G., Murray K.T., Harlan E.T. Effortful control in early childhood: continuity and change, antecedents, and implications for social development. *Developmental Psychology*. 2000;36(2):220–232. doi:10.1037/0012-1649.36.2.220

36. Callard-Szulgit R. *Twice-Exceptional Kids: A Guide for Assisting Students Who Are Both Academically Gifted and Learning Disabled*. Lanham, MD: Rowman & Littlefield Education; 2008. 126 p.

37. Baum S.M., Schader R.M., Owen S.V. *To Be Gifted and Learning Disabled: Strength-Based Strategies for Helping Twice-Exceptional Students with LD, ADHD, ASD, and More*. Routledge; 2021. 316 p.

38. Bailey N.W., Freedman G., Raj K., Spierings K.N., Piccoli L.R., Sullivan C.M., et al. Mindfulness meditators show enhanced accuracy and different neural activity during working memory. *Mindfulness*. 2020;11(7):1762–1781. doi:10.1007/s12671-020-01393-8

39. Gonzalez N.A., Sakhamuri N., Athiyaman S., Randhi B., Gutlapalli S.D., Pu J., et al. A systematic review of yoga and meditation for attention-deficit/hyperactivity disorder in children. *Cureus*. 2023;15(3). doi:10.7759/cureus.36143

40. Bigelow H., Gottlieb M.D., Ogrodnik M., Graham J.D., Fenesi B. The differential impact of acute exercise and mindfulness meditation on executive functioning and psycho-emotional well-being in children and youth with ADHD. *Frontiers in Psychology*. 2021;12. doi:10.3389/fpsyg.2021.660845

41. Hammerdahl E., Hilt L.M., Draheim A., Fox G., Breister E. The role of attention control in a mindfulness-based intervention for rumination: a randomized controlled trial. *Mindfulness*. 2025;16:102–118. doi:10.1007/s12671-024-02499-z

42. Nesrine B.M., Jarraya S., Caprioli L. The effectiveness of a mindfulness-based program in improving cognitive and socio-affective skills among adolescents with intellectual and developmental disabilities: a randomized controlled study. *Mindfulness*. 2024;16:133–148. doi:10.1007/s12671-024-02495-3

43. Hammad M.A., Shalhoub H.A.B. Effects of a mindfulness-based program in improving self-regulation and attention among hard-of-hearing children: a preliminary investigation. *Mindfulness*. 2024;15:2929–2939. doi:10.1007/s12671-024-02414-6

44. Makmee P. Increasing attention and working memory in elementary students using mindfulness training programs. *FWU Journal of Social Sciences*. 2022;16(3):107–119. doi:10.51709/19951272/Fall2022/8

45. Bokk O., Forster B. The effect of a short mindfulness meditation on somatosensory attention. *Mindfulness*. 2022;13:2022–2030. doi:10.1007/s12671-022-01938-z

46. Li Y., Yang N., Zhang Y., Xu W., Cai L. The relationship among trait mindfulness, attention, and working memory in junior school students under different stressful situations. *Frontiers in Psychology*. 2021;12. doi:10.3389/fpsyg.2021.558690

47. DuPaul G.J., Power T.J., Anastopoulos A.D., Reid R. *ADHD Rating Scale? 5 for Children and Adolescents: Checklists, Norms, and Clinical Interpretation*. Guilford Publications; 2016. 124 p. Accessed July 05, 2025. https://books.google.com/books?hl=en&lr=&id=FkG8CwAAQBAJ&oi=fnd&pg=PA1&dq=the+ADHD+Rating+Scale%E2%80%93School+and+Home+Versions+developed+by+DuPaul+et+al.+(2016),+&ots=xg3-GFUT4C&sig=0wLJ-ALUA7xrJG34CWgCtAgbvuU

48. Alhossein A.H., Bukhit S.F., Aljunaydil J.I. Saudi standards of school version for the ADHD Rating Scale-5 for children and adolescents. *Journal of Special Education*. 2018;23:212–237. Accessed July 05, 2025. https://search.mandumah.com/Record/915608

49. Lutz A., Slagter H.A., Dunne J.D., Davidson R.J. Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences*. 2008;12(4):163–169. doi:10.1016/j.tics.2008.01.005

50. Deci E.L., Ryan R.M. The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*. 2000;11(4):227–268. doi:10.1207/S15327965PLI1104_01

51. Bustamante L., Lieder F., Musslick S., Shenhav A., Cohen J. Learning to overexert cognitive control in a Stroop task. *Cognitive, Affective, & Behavioral Neuroscience*. 2021;21(3):453–471. Accessed July 05, 2025. https://link.springer.com/article/10.3758/s13415-020-00845-x

52. Eriksen B.A., Eriksen C.W. Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics*. 1974;16(1):143–149. doi:10.3758/BF03203267

53. Corbetta M., Shulman G.L. Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience*. 2002;3(3):201–215. doi:10.1038/nrn755
54. Simon J.R., Wolf J.D. Choice reaction time as a function of angular stimulus-response correspondence and age. *Ergonomics*. 1963;6(1):99–105. doi:10.1080/00140136308930679
55. Draheim C., Tsukahara J.S., Martin J.D., Mashburn C.A., Engle R.W. A toolbox approach to improving the measurement of attention control. *Journal of Experimental Psychology: General*. 2021;150(2):242–275. doi:10.1037/xge0000783
56. Sahu P., Chattu V.K., Rewatkar A., Sakhamuri S. Prevalence and predictors of academic stress among medical and engineering students: a comparative study. *Journal of Mental Health and Human Behaviour*. 2019;24(2):97–104. doi:10.4103/jmhhb.jmhhb_5_19
57. Hwang G.J., Chiu L.Y., Chen C.H. A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses. *Computers & Education*. 2016;81:13–25. doi:10.1016/j.compedu.2014.09.006
58. Hofmann S.G., Sawyer A.T., Witt A.A., Oh D. The effect of mindfulness-based therapy on anxiety and depression: a meta-analytic review. *Journal of Consulting and Clinical Psychology*. 2010;78(2):169–183. doi:10.1037/a0018555
59. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clinical Psychology: Science and Practice*. 2003;10(2):144–156. doi:10.1093/clipsy.bpg016

Information about the authors:
Badrya Moaed Alotaibi – PhD Student, Department of Special Education, College of Education, King Faisal University, Al Ahsa, Saudi Arabia; ORCID 0009-0002-1087-6199. E-mail: alotaibibadrya1@gmail.com
Sumaihan Naser Alrashidi – Associate Professor, Department of Special Education, College of Education, King Faisal University, Al Ahsa, Saudi Arabia; ORCID 0009-0001-2800-1756. E-mail: salrashidi@kfu.edu.sa
Atef Abdallah Bahrawi – Professor, Department of Special Education, College of Education, King Faisal University, Al Ahsa, Saudi Arabia; ORCID 0000-0003-0363-1310. E-mail: att21ef2030@gmail.com

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Информация об авторах:
Алотаиби Бадрия Моаед – аспирантка кафедры специального образования Педагогического колледжа Университета короля Фейсала, Аль-Ахса, Саудовская Аравия; ORCID 0009-0002-1087-6199. E-mail: alotaibibadrya1@gmail.com
Альрашиди Сумайхан Насер – доцент кафедры специального образования Педагогического колледжа Университета короля Фейсала, Аль-Ахса, Саудовская Аравия; ORCID 0009-0001-2800-1756. E-mail: salrashidi@kfu.edu.sa
Бахрави Атеф Абдалла – профессор кафедры специального образования Педагогического колледжа Университета короля Фейсала, Аль-Ахса, Саудовская Аравия; ORCID 0000-0003-0363-1310. E-mail: att21ef2030@gmail.com

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