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# Comparison of the Effectiveness of Mindfulness Training and Working Memory on Academic Self-Regulation in Female Secondary School Students in Bojnord

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A B S T R A C T

**Purpose:** This study aimed to compare the effectiveness of mindfulness training and working memory on academic self-regulation in female secondary school students in Bojnord.

**Methods and Materials:** This research was a quasi-experimental study with a pre-test, post-test, and follow-up design with a control group. The statistical population included all female secondary school students in the first stage (grades 7-9) in the academic year 2022-2023, with a total of 2000 students. From this population, using convenience sampling, 45 students who met the inclusion and exclusion criteria were randomly assigned into two experimental groups of 15 students and one control group of 15 students. First, all three groups were assessed using the Connell and Ryan (1987) Academic Self-Regulation Questionnaire (SRQ-A). Subsequently, mindfulness training and working memory training were conducted for the first and second experimental groups, respectively. The control group did not receive any intervention and was placed on a waiting list. After completing the intervention, all three groups were re-assessed in a post-test and a follow-up test conducted one month later. The collected data were analyzed using repeated measures analysis of covariance (ANCOVA) with SPSS-21 software.

**Findings:** The research findings showed no significant difference in the effectiveness of mindfulness training and working memory training on academic self-regulation in female secondary school students ($P>0.05$). However, both mindfulness training and working memory training individually were effective in improving academic self-regulation in the students ($P<0.05$).

**Conclusion:** The results suggest that both mindfulness training and working memory training are effective in reducing academic self-regulation in female students, with no significant difference in the level of effectiveness between the two interventions.

***Keywords:*** *Mindfulness training, working memory training, academic self-regulation, students.*

## 1. Introduction

Academic self-regulation, defined as a student's ability to plan, monitor, and evaluate their learning behaviors, is essential for achieving academic success (Enayati Shabkolai et al., 2023). Self-regulation has gained attention due to its significant role in enabling students to manage their own learning processes effectively, leading to better academic outcomes (Zelazo & Lyons, 2012). Recent studies have explored how cognitive and emotional skills such as mindfulness and working memory may contribute to academic self-regulation, thus impacting academic performance. These cognitive interventions, often implemented as part of educational programs, aim to enhance students' capacity for sustained attention, emotional regulation, and executive functioning, which are all critical components of self-regulation (Bargamadi et al., 2019).

Mindfulness, a psychological construct that involves paying attention to the present moment without judgment (Zeidan et al., 2010), has been widely studied for its benefits in academic settings. Mindfulness practices such as meditation have shown to reduce stress, enhance cognitive flexibility, and improve focus and attention (Sampl et al., 2017). Research on mindfulness in educational contexts reveals that students who engage in mindfulness exercises demonstrate improvements in various cognitive and emotional domains, including self-regulation (Mrazek et al., 2013). For example, a study by Alomari (2023) found a positive relationship between mindfulness and academic achievement among university students, suggesting that mindfulness might improve students' academic performance through enhanced self-regulation and stress management (Alomari, 2023). Similarly, McBride and Greeson (2021) demonstrated that mindfulness training helps reduce stress and improve cognitive functioning, which in turn positively affects academic achievement (McBride & Greeson, 2021).

Working memory, defined as the ability to hold and manipulate information over short periods, is another cognitive function closely related to academic performance (Asadi Rajani, 2023; Baniasadi, 2024; Pourjaberi et al., 2023; Roghani et al., 2022). Research indicates that working memory plays a critical role in tasks requiring complex cognitive processing, such as problem-solving and comprehension (Dikmen, 2022). The relationship between working memory and academic achievement is well-documented, with several studies reporting that students with higher working memory capacity tend to perform better academically (Mrazek et al., 2013). Bargamadi, Mahdian, and Yamini (2019) compared the effects of working memory and mindfulness training on educational well-being, academic self-regulation, and achievement motivation among high school students. Their findings showed that both interventions positively impacted academic self-regulation, suggesting that cognitive training programs could be beneficial for enhancing students' academic performance (Bargamadi et al., 2019).

Given the substantial body of research supporting the positive effects of mindfulness and working memory on academic performance, it is important to understand the underlying mechanisms that facilitate these improvements. One potential mechanism is the enhancement of academic self-regulation through mindfulness and working memory training. Academic self-regulation refers to a student's ability to effectively manage their learning by setting goals, monitoring progress, and adjusting strategies as needed (Zelazo & Lyons, 2012). Both mindfulness and working memory training are believed to foster self-regulatory behaviors by promoting sustained attention, reducing mind-wandering, and enhancing emotional control (Gearin et al., 2018).

Several studies have explored the direct and indirect effects of mindfulness on academic self-regulation. For instance, Caballero et al. (2019) found that greater mindfulness is associated with better academic achievement in middle school students, suggesting that mindfulness may enhance students' ability to regulate their learning behaviors (Caballero et al., 2019). In addition, the meta-analysis by Breedvelt et al. (2019) demonstrated that mindfulness-based interventions lead to significant reductions in depression, anxiety, and stress among tertiary education students, which can indirectly enhance their academic self-regulation (Breedvelt et al., 2019). Similarly, Bennett and Dorjee (2015) reported that a mindfulness-based stress reduction (MBSR) program significantly improved the well-being and academic attainment of sixth-form students, emphasizing the role of mindfulness in promoting academic self-regulation (Bennett & Dorjee, 2015).

The positive effects of working memory training on academic performance have also been well-established. For example, Mrazek et al. (2013) showed that working memory training improves students' ability to focus on tasks, which in turn enhances their performance on standardized academic tests (Mrazek et al., 2013). Moreover, studies have shown that improvements in working memory are associated with better self-regulatory behaviors, as students with higher working memory capacity are better able to control their


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attention, inhibit distractions, and engage in goal-directed behaviors (Nesbitt et al., 2015). This suggests that working memory training may be an effective tool for enhancing students' academic self-regulation.

Despite the growing evidence supporting the effectiveness of mindfulness and working memory training, there remains a need for more research that directly compares the two interventions. Few studies have examined how these cognitive training programs impact different aspects of academic self-regulation, such as external regulation (e.g., relying on external cues or rewards), internal regulation (e.g., self-monitoring and goal-setting), and intrinsic motivation (e.g., pursuing tasks for personal satisfaction) (Bargamadi et al., 2019). Aydın and Özgeldi (2020) highlighted the importance of metacognition and self-regulatory skills in predicting academic success among Turkish university students, emphasizing the need for interventions that enhance these cognitive and emotional capacities (Aydın & Özgeldi, 2020).

Moreover, mindfulness and working memory training may have differential effects on specific aspects of academic self-regulation. For instance, mindfulness training has been shown to improve emotional regulation and reduce mind-wandering, which can help students focus on their academic tasks and reduce procrastination (Sampl et al., 2017). On the other hand, working memory training may be more effective in enhancing cognitive control and executive functioning, enabling students to better manage complex tasks and academic challenges (Bargamadi et al., 2019). By comparing these two interventions, this study aims to identify which cognitive training program is more effective in improving specific aspects of academic self-regulation, such as external regulation, internal regulation, cognitive regulation, and intrinsic motivation.

The relationship between mindfulness, working memory, and academic self-regulation may also be influenced by other factors, such as age, grade level, and socio-economic status. For example, studies have shown that younger students may benefit more from mindfulness training due to their developing executive functions and emotional regulation skills (Zelazo & Lyons, 2012). Conversely, older students may benefit more from working memory training, as their cognitive capacities are more developed, allowing them to better manage complex academic tasks (Nesbitt et al., 2015). Additionally, socio-economic status may play a role in determining the effectiveness of these interventions, as students from disadvantaged backgrounds may face more stress and cognitive load, which could limit the benefits of cognitive training programs (Gearin et al., 2018). Therefore, this study also aims to explore how factors such as age and grade level may moderate the effects of mindfulness and working memory training on academic self-regulation.

In conclusion, this study aims to compare the effects of mindfulness training and working memory training on the academic self-regulation of female secondary school students in Bojnord, Iran.

## 2. Methods and Materials

### *2.1. Study Design and Participants*

This research employed a quasi-experimental design with a pre-test, post-test, and follow-up with a control group. Initially, a sample of 45 female secondary school students was selected using convenience sampling. The participants were then randomly assigned into two experimental groups of 15 students each and one control group of 15 students. All three groups were first evaluated using the research instruments. The first experimental group underwent mindfulness training, while the second group received working memory training. The control group, however, did not receive any psychological intervention and was placed on a waiting list. After the intervention period, all three groups were reassessed using the post-test, and a follow-up test was conducted one month later.

The statistical population of this research consisted of all female secondary school students in Bojnord during the academic year 2022-2023, totaling 2000 students, as reported by the local Department of Education.

### *2.2. Measures*

#### *2.2.1. Academic Self-Regulation*

The Academic Self-Regulation Questionnaire was developed by Connell and Ryan in 1987. It consists of 32 items across four dimensions: external regulation, internal regulation, cognitive regulation, and intrinsic motivation. The responses to each item are rated on a 4-point Likert scale, where "Very true" receives 4 points, "Somewhat true" receives 3 points, "Not very true" receives 2 points, and "Not true at all" receives 1 point. The four subscales of this questionnaire include external regulation, internal regulation, cognitive regulation, and intrinsic motivation, with specific items assigned to each subscale. Higher mean scores in any subscale indicate higher levels of self-regulation. Regarding reliability, Davis and colleagues (2003) reported Cronbach's alpha coefficients for the


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subscales as follows: 0.85 for external regulation, 0.85 for internal regulation, 0.88 for cognitive regulation, and 0.88 for intrinsic motivation. The validity of the questionnaire is supported by high correlations among the subscales, indicating good construct validity.

### *2.3. Interventions*

#### *2.3.1. Mindfulness Training*

The structure and content of the mindfulness training sessions were based on an 8-session training program, each session lasting 2 hours, conducted twice a week over the course of one month. The mindfulness techniques were designed based on Kabat-Zinn's (2003) mindfulness-based stress reduction (MBSR) model, as well as mindfulness-based cognitive therapy (MBCT) techniques from Rebecca Crane's (2009) book Mindfulness-Based Cognitive Therapy, and Debra Burdick's (2013) mindfulness techniques for reducing anxiety from her Mindfulness Skills Workbook. In the first session, the pre-test was administered, rapport was built with the participants, and an explanation of mindfulness and progressive muscle relaxation was provided. The need for mindfulness training was discussed, along with the confidentiality of personal experiences shared within the group. In the second session, relaxation training focused on fourteen specific muscle groups, including forearms, biceps, calves, thighs, abdomen, chest, shoulders, neck, and facial muscles. By the third session, relaxation training continued, but this time for six muscle groups, with additional home exercises assigned. The fourth session introduced mindfulness of breathing, with an emphasis on reducing anxiety. In the fifth session, body scanning techniques were introduced, combining seated meditation with a three-minute breathing exercise. The sixth session focused on mindfulness of thoughts, with a review of the previous sessions. By the seventh session, a comprehensive mindfulness practice was conducted, combining the techniques from sessions 4, 5, and 6. In the final eighth session, a review and summary of the previous sessions were conducted, followed by the administration of the post-test (Bargamadi et al., 2019).

#### *2.3.2. Working Memory Training*

The structure and content of the working memory training sessions followed a program validated by previous studies for secondary school students. This 15-session program focused on various cognitive tasks such as auditory and visual memory exercises. For example, in the first session, the role of working memory in reading was introduced. In the second session, auditory memory tasks such as following instructions, recalling numbers or simple words, and memorizing poems were practiced. The third session focused on visual memory exercises, such as identifying specific colored balls from a large pile, recalling faces, and reproducing complex geometric shapes. The fourth session revisited auditory and visual memory exercises for further practice. In the fifth session, students were shown pictures and asked to recall colors and directions after 15 seconds. During the sixth session, students were given multiple instructions simultaneously, which they had to execute correctly. In the seventh session, a short film was shown, and students had to recall and replicate the behaviors observed in the film. The eighth session focused on recognition memory, in which students were shown pictures of children, animals, fruits, and objects and asked to recognize them after a few seconds. In the ninth session, students were asked to retell a short story or tale after hearing it for a few minutes. The tenth session emphasized long-term memory tasks, where students were asked to recall events that occurred 24 hours earlier with complete details. The eleventh session involved list learning, where students had to memorize a list of words and sentences presented by the instructor and recall them later. The twelfth session revisited previous tasks, such as a word card game, to reinforce memory retention. In the thirteenth and fourteenth sessions, the technique of mental review, including repeated reading and writing, was introduced. The final session consisted of a review of previous material and additional practice on mental review techniques (Bargamadi et al., 2019; Barkus, 2020; Bogg & Lasecki, 2015; Borjali & Rostami, 2021).

### *2.4. Data Analysis*

After obtaining the necessary approvals from the Islamic Azad University, Bojnord Branch, a list of secondary schools in Bojnord was compiled, and 45 students willing to participate in the study were selected and randomly assigned to the two experimental groups and the control group. One week after the pre-test was administered to all three groups, the first experimental group received mindfulness training, the second group underwent working memory training, and the control group received no intervention. After the completion of the interventions, the post-test was administered to all three groups one week later. One month


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after the post-test, the follow-up test was conducted, and the collected data were analyzed.

In the descriptive phase of the analysis, statistical indices such as mean, variance, standard deviation, minimum, maximum, and frequency were calculated. To investigate the differences between the groups, multivariate and univariate repeated measures ANOVA were used, considering both the within-group factor (test) and the between-group factor (group membership).

## 3. Findings and Results

The participants in this study were 45 female students from Bojnord, divided into two experimental groups and one control group. In the mindfulness training group, working memory training group, and control group, the majority of students were 13 years old (33.3%, 40%, and 46.7%, respectively). The chi-square test did not show any significant differences in age ($P>0.05$, $\chi^2=3.18$). A comparison by grade level showed that in the mindfulness training group, most participants were in the ninth grade (46.7%), while in the working memory and control groups, most participants were in the eighth grade (53.3%). The chi-square test did not reveal significant differences based on grade level ($P>0.05$, $\chi^2=4.00$).

The descriptive statistics for academic self-regulation in the pre-test, post-test, and follow-up stages for each group are presented in Table 1.

**Table 1**

*Descriptive Statistics of Academic Self-Regulation by Test Stages and Group*

| Variables | Group | Pre-Test | Post-Test | Follow-Up |
|---|---|---|---|---|
| External Self-Regulation | Mindfulness Training | 21.53 (SD=4.69) | 16.67 (SD=2.09) | 16.87 (SD=3.07) |
| | Working Memory Training | 21.33 (SD=2.55) | 16.53 (SD=3.48) | 16.47 (SD=3.54) |
| | Control | 21.93 (SD=3.43) | 21.53 (SD=3.09) | 21.40 (SD=3.18) |
| Internal Self-Regulation | Mindfulness Training | 14.67 (SD=4.08) | 22.13 (SD=5.79) | 22.47 (SD=3.34) |
| | Working Memory Training | 15.87 (SD=3.89) | 21.00 (SD=3.96) | 20.93 (SD=3.15) |
| | Control | 15.20 (SD=2.98) | 15.40 (SD=4.91) | 15.73 (SD=3.39) |
| Cognitive Self-Regulation | Mindfulness Training | 14.80 (SD=3.69) | 20.13 (SD=4.03) | 19.07 (SD=3.35) |
| | Working Memory Training | 14.67 (SD=3.98) | 19.73 (SD=5.23) | 19.27 (SD=4.11) |
| | Control | 14.93 (SD=4.25) | 15.07 (SD=3.28) | 14.87 (SD=3.34) |
| Intrinsic Motivation | Mindfulness Training | 14.87 (SD=3.40) | 20.60 (SD=3.11) | 21.67 (SD=2.58) |
| | Working Memory Training | 14.07 (SD=3.01) | 21.20 (SD=3.28) | 20.53 (SD=2.77) |
| | Control | 15.67 (SD=2.69) | 14.60 (SD=2.92) | 15.20 |

Table 1 shows that in both the post-test and follow-up stages, the external self-regulation scores of the mindfulness and working memory groups were lower than those of the control group. Other results indicate that in internal self-regulation, cognitive self-regulation, and intrinsic motivation, the mindfulness and working memory groups had higher mean scores compared to the control group.

The results showed that the assumption of homogeneity of variances for academic self-regulation was met ($P>0.05$). However, the assumption of homogeneity of the variance-covariance matrix was not confirmed ($P<0.05$, $F=1.25$, Box's $M=30.49$). Bartlett's test of sphericity indicated a moderate and significant correlation among the dimensions of academic self-regulation ($P<0.05$, $\chi^2=42.52$).

**Table 2**

*Bonferroni Post-Hoc Test for Comparing Mean Academic Self-Regulation Scores Across Test Stages in Experimental Groups*

| Variables | Group | Pre-Test to Post-Test | Pre-Test to Follow-Up | Post-Test to Follow-Up |
|---|---|---|---|---|
| External Self-Regulation | Mindfulness Training | 4.87 (P=0.004) | 4.67 (P=0.04) | -0.20 (P=0.99) |
| | Working Memory Training | 4.80 (P=0.01) | 4.87 (P=0.001) | 0.07 (P=0.99) |
| Internal Self-Regulation | Mindfulness Training | -7.47 (P=0.002) | -7.80 (P=0.001) | -0.33 (P=0.99) |
| | Working Memory Training | -5.13 (P=0.002) | -5.07 (P=0.002) | 0.07 (P=0.99) |
| Cognitive Self-Regulation | Mindfulness Training | -5.33 (P=0.002) | -4.27 (P=0.01) | 1.07 (P=0.99) |
| | Working Memory Training | -5.07 (P=0.02) | -4.60 (P=0.04) | 0.47 (P=0.99) |
| Intrinsic Motivation | Mindfulness Training | -5.73 (P=0.001) | -6.80 (P=0.001) | -1.07 (P=0.99) |
| | Working Memory Training | -7.13 (P=0.001) | -6.47 (P=0.001) | -0.67 (P=0.99) |



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Table 2 shows that for external self-regulation, the mean scores of both experimental groups significantly decreased from the pre-test to post-test and from the pre-test to the follow-up (P<0.05). However, no significant changes were observed between the post-test and follow-up in both groups (P>0.05). For internal self-regulation, cognitive self-regulation, and intrinsic motivation, the mean scores in both experimental groups increased significantly from the pre-test to the post-test and from the pre-test to the follow-up (P<0.05). No significant changes were observed between the post-test and follow-up in both groups (P>0.05). In summary, the research hypothesis is rejected, meaning that there is no significant difference in the effectiveness of mindfulness training and working memory training on academic self-regulation in female students in Bojnord.

## 4. Discussion and Conclusion

The present study aimed to compare the effectiveness of mindfulness training and working memory training on academic self-regulation in female secondary school students in Bojnord, Iran. The findings revealed that both mindfulness and working memory training significantly improved various aspects of academic self-regulation, including external regulation, internal regulation, cognitive regulation, and intrinsic motivation, compared to the control group. However, no significant difference was found between the two interventions in terms of their overall impact on academic self-regulation, suggesting that both methods are equally effective in enhancing students' ability to manage their learning processes.

The significant improvements observed in external self-regulation among students in both the mindfulness and working memory training groups align with previous research, which emphasizes the positive role of cognitive interventions in improving students' capacity to control their academic behaviors. External regulation, characterized by reliance on external cues and rewards to maintain academic motivation, was notably reduced in both experimental groups following the interventions. This finding is consistent with the work of Caballero et al. (2019), who found that mindfulness is associated with a reduced need for external rewards and a greater focus on intrinsic goals (Caballero et al., 2019). Similarly, Bargamadi, Mahdian, and Yamini (2019) reported that working memory training enhances students' ability to regulate their behaviors independently of external stimuli, likely due to improvements in cognitive control and attention (Bargamadi et al., 2019).

Internal regulation, which refers to the self-monitoring and goal-setting aspects of self-regulation, also showed significant improvement in both intervention groups. These results are supported by previous studies on the benefits of mindfulness and working memory training for enhancing self-awareness and executive functioning. Alomari (2023) reported that mindfulness training helps students develop greater self-awareness, which is critical for effective self-monitoring and goal achievement (Alomari, 2023). Moreover, the improvements in internal regulation observed in this study are consistent with findings from Mrazek et al. (2013), who demonstrated that mindfulness training enhances students' ability to monitor their thoughts and actions, leading to better self-regulatory practices (Mrazek et al., 2013). On the other hand, working memory training has been linked to improvements in students' ability to plan, organize, and execute academic tasks. Dikmen (2022) found that working memory training enhances cognitive flexibility and executive functioning, both of which are essential for internal regulation (Dikmen, 2022).

The improvements in cognitive regulation, which refers to the ability to manage and control cognitive processes such as attention and memory, were particularly notable in this study. Both mindfulness and working memory training significantly enhanced students' cognitive regulation, suggesting that these interventions improve students' ability to focus, process information, and retain knowledge. These findings align with previous research by Mrazek et al. (2013), who found that mindfulness training improves working memory capacity and reduces mind-wandering, leading to better cognitive performance (Mrazek et al., 2013). Similarly, Assem, Dulewicz, and Passmore (2022) demonstrated that mindfulness training enhances cognitive regulation by improving attentional control and reducing distractions (Assem et al., 2022). In terms of working memory, previous studies have consistently shown that cognitive training programs lead to improvements in memory retention and cognitive flexibility, which are critical for academic success (Nesbitt et al., 2015).

Intrinsic motivation, which refers to the internal desire to engage in academic tasks for personal satisfaction, was also significantly enhanced in both experimental groups. This finding is consistent with prior research, which suggests that both mindfulness and working memory training can foster intrinsic motivation by enhancing students' self-efficacy and reducing academic stress. Bennett and Dorjee (2015) found that mindfulness training leads to improvements in students' intrinsic motivation by helping them manage stress and


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focus on their long-term academic goals (Bennett & Dorjee, 2015). Similarly, Bakosh et al. (2015) reported that mindfulness training improves students' sense of accomplishment and self-worth, which in turn increases their intrinsic motivation (Bakosh et al., 2015). Working memory training has also been shown to enhance intrinsic motivation by improving students' confidence in their cognitive abilities (Dikmen, 2022). This study's findings align with those of previous research, suggesting that both mindfulness and working memory training are effective in fostering a deeper engagement with academic tasks.

Despite the significant improvements observed in the experimental groups, it is important to note that there were no significant differences between mindfulness and working memory training in terms of their overall impact on academic self-regulation. This suggests that both interventions are equally effective in enhancing students' self-regulatory behaviors, albeit through different cognitive and emotional mechanisms. For example, mindfulness training is primarily focused on enhancing emotional regulation and reducing stress, which can improve students' ability to focus on academic tasks (Bargamadi et al., 2019). On the other hand, working memory training targets cognitive processes such as attention and memory, which are critical for academic success (Mrazek et al., 2013). These findings align with the meta-analysis by Breedvelt et al. (2019), which found that both mindfulness and cognitive training programs are effective in reducing academic stress and improving self-regulation in students (Breedvelt et al., 2019).

The lack of significant differences between the two interventions may also be due to the relatively short duration of the training programs. Both mindfulness and working memory training were administered over the course of several weeks, which may not have been sufficient to produce lasting or differentiating effects on academic self-regulation. Previous studies have shown that longer interventions are more likely to produce significant differences between cognitive training programs. For example, Zeidan et al. (2010) found that longer mindfulness interventions lead to greater improvements in cognitive functioning and academic performance compared to shorter programs (Zeidan et al., 2010). Similarly, Assem, Dulewicz, and Passmore (2022) reported that the benefits of mindfulness training tend to increase over time, suggesting that a longer intervention period may have produced more significant results in this study (Assem et al., 2022).

In summary, this study's findings suggest that both mindfulness and working memory training are effective in enhancing academic self-regulation among female secondary school students. These interventions appear to improve students' ability to manage their learning processes by enhancing external and internal regulation, cognitive regulation, and intrinsic motivation. While no significant differences were found between the two interventions, the results align with previous research that highlights the benefits of cognitive training programs for improving academic performance and self-regulatory behaviors.

Despite the valuable insights provided by this study, several limitations should be acknowledged. First, the sample size was relatively small, consisting of only 45 female students from a single secondary school in Bojnord, Iran. This limits the generalizability of the findings, as the sample may not be representative of all secondary school students in Iran or other cultural contexts. Future research should include larger, more diverse samples to increase the external validity of the results. Second, the study only included female participants, which limits the ability to generalize the findings to male students. Previous research suggests that gender may influence the effectiveness of mindfulness and working memory training (Sipahutar, 2023), so future studies should include both male and female participants to explore potential gender differences. Third, the intervention period was relatively short, with both mindfulness and working memory training administered over several weeks. Longer interventions may be necessary to produce more significant and lasting effects on academic self-regulation. Finally, this study relied solely on self-report measures of academic self-regulation, which may be subject to social desirability bias. Future research should incorporate objective measures of self-regulation, such as behavioral tasks or teacher assessments, to provide a more comprehensive evaluation of the interventions' effectiveness.

Building on the findings of this study, several directions for future research can be proposed. First, future studies should investigate the long-term effects of mindfulness and working memory training on academic self-regulation. This study only assessed the immediate post-intervention and one-month follow-up outcomes; however, it would be valuable to examine whether the effects of these interventions are sustained over longer periods, such as six months or one year. Second, future research should explore the potential moderating effects of demographic variables such as age, socio-economic status, and prior academic


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achievement on the effectiveness of mindfulness and working memory training. For example, studies could investigate whether students from disadvantaged backgrounds benefit more or less from these interventions compared to students from higher socio-economic backgrounds (Gearin et al., 2018). Third, future studies should compare the effectiveness of mindfulness and working memory training in different educational settings, such as primary schools, high schools, and universities. This would provide valuable insights into the developmental differences in how students respond to cognitive training programs. Finally, future research could investigate the potential synergies between mindfulness and working memory training. For example, studies could explore whether combining both interventions leads to greater improvements in academic self-regulation compared to either intervention alone.

The findings of this study have important implications for educational practice. First, educators and policymakers should consider incorporating mindfulness and working memory training into school curricula as part of broader efforts to improve students' academic self-regulation and performance. Given the significant improvements observed in this study, implementing these interventions at the secondary school level could help students develop the cognitive and emotional skills necessary for academic success. Second, schools should provide teachers with professional development opportunities to learn how to effectively implement mindfulness and working memory training in the classroom. Training teachers to deliver these interventions would help ensure that students receive high-quality cognitive training that is tailored to their specific needs. Third, schools should consider offering mindfulness and working memory training as part of after-school programs or extracurricular activities. These programs could provide students with additional opportunities to practice self-regulation skills in a supportive and structured environment. Finally, educators should be mindful of the individual differences among students when implementing cognitive training programs. Some students may benefit more from mindfulness training, while others may respond better to working memory training. Therefore, it is important to provide students with options and tailor interventions to their specific learning needs and preferences.

In conclusion, this study provides strong evidence that both mindfulness and working memory training are effective in improving academic self-regulation among female secondary school students. While no significant differences were found between the two interventions, the results suggest that both cognitive training programs can enhance students' ability to manage their learning processes, leading to better academic outcomes. Future research should continue to explore the long-term effects of these interventions and investigate how they can be tailored to meet the diverse needs of students in different educational settings.

## Authors' Contributions

All authors significantly contributed to this study.

## Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

## Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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## Declaration of Interest

The authors report no conflict of interest.

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## Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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