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Examining the Effectiveness of Emotional Self-Regulation Skills on Cognitive Flexibility and Working Memory of Students

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A B S T R A C T

Objective: The purpose of this study was to examine the effectiveness of emotional self-regulation skills training on cognitive flexibility and working memory among ninth-grade students in Jajrom.

Methods and Materials: This quasi-experimental study employed a pre-test, post-test, and follow-up design with control and experimental groups. The statistical population comprised all ninth-grade students in Jajrom during the 2022-2023 academic year. A total of 60 students were selected through cluster sampling and randomly assigned to either the experimental group, which received emotional self-regulation skills training, or the control group, which did not receive any intervention. Data were collected using the Daneman and Carpenter (1980) Working Memory Test and the Dennis and Vander Wal (2010) Cognitive Flexibility Inventory. Data were analyzed using SPSS software and multivariate covariance analysis (MANCOVA).

Findings: The results indicated that the experimental group showed significant improvements in emotional self-regulation skills, cognitive flexibility, and working memory from pre-test to post-test and follow-up stages. Specifically, the mean scores for emotional self-regulation skills increased from 74.7 to 99.4, cognitive flexibility from 69.3 to 79.1, and working memory from 57.6 to 80.2. In contrast, the control group did not exhibit any significant changes in these measures.

Conclusion: The findings suggest that emotional self-regulation skills training significantly enhances cognitive flexibility and working memory among ninth-grade students. These improvements indicate that such training can be a valuable intervention to boost psychological flexibility and academic performance. The results align with previous studies, supporting the effectiveness of emotional self-regulation training in educational settings.

Keywords: *emotional self-regulation skills, cognitive flexibility, working memory.*

1. Introduction

The importance of cognitive flexibility is evident in its association with various mental health issues and behavioral disorders. Research has demonstrated the relationship between cognitive flexibility and depression (Novakovic-Agopian et al., 2020). An inflexible cognitive style in depressed individuals influences attentional bias, leading to the automatic acceptance of inefficient thoughts and information, thereby reinforcing depression (Taghavi et al., 2021). Hence, enhancing flexibility in depressed individuals through challenging inefficient thoughts can reduce depressive mood. Furthermore, researchers have shown that cognitively inflexible individuals tend to engage in rumination—a repetitive, intrusive, and uncontrollable thinking style—during distress, focusing their cognitive resources on unproductive ruminative responses (Sanagaoi Moharrar & Mir Shekari, 2019). Inflexibility fosters irrational thoughts, which lead to distress, anxiety, and various life problems (Jafari & Mollaei, 2019). Additionally, the relationship between cognitive flexibility and certain mental health issues, including obsessive-compulsive disorder (Hasani et al., 2020), eating disorders, and family conflicts (Haqnazari et al., 2022), has been examined. Cognitive flexibility has also been linked to problem-solving skills and resilience (Sanagaoi Moharrar & Mir Shekari, 2019).

Over the past decades, identifying cognitive mechanisms foundational to children's learning has been a focus of educational research. One such mechanism is working memory, a limited-capacity system responsible for storing and integrating information during complex and demanding tasks (Azunny et al., 2020). These tasks commonly occur in classroom settings, such as remembering instructions while performing a task, writing while organizing the next part of a text, or employing mental calculations. Consequently, children may fail in learning activities due to insufficient working memory resources (Chevalère et al., 2023). Working memory is now considered a crucial factor in preventive interventions for children at risk of academic underachievement, with recent studies indicating that working memory is a significant and modifiable factor for low academic performance. It has also been shown that working memory can be improved and enhanced through adaptive training tasks (da Silva et al., 2023). Studies on working memory have demonstrated its connection to performance among elementary students (Deng et al., 2020), middle and high school students, and university students (Akbarzadeh & Zahrakar, 2022). Working memory is vital in learning because it integrates long-term memory knowledge and temporary information (Zhou et al., 2020), and children with weak working memory capacity are limited in performing crucial classroom tasks. In this regard, Emamverdi (2020) investigated the role of cognitive flexibility and mindfulness in predicting students' academic procrastination. This descriptive-correlational study revealed that cognitive flexibility and mindfulness could predict academic procrastination. Cognitive flexibility enables individuals to respond appropriately and effectively to emotional and social pressures, while mindfulness allows individuals to live in the moment and appreciate time and opportunities, thus reducing academic procrastination (Emamverdi & Taher, 2020). Considering the positive impact of emotional self-regulation on cognitive flexibility and working memory in students, investigating this topic is essential. This research focuses on ninth-grade students, a crucial period for entering a new educational stage, selecting academic majors, and determining future career paths. Given the provided information and the gaps in previous research, this study aims to examine the impact of emotional self-regulation skills on cognitive flexibility and working memory among ninth-grade students in Jajrom.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a quasi-experimental design with pre-test, post-test, and follow-up stages, along with a control group. There were two experimental groups and one control group, with pre-test, post-test, and follow-up assessments conducted for all three groups. The statistical population included all ninth-grade students in the first grade of secondary school in Jajrom during the 2022-2023 academic year, studying in public, non-public (non-profit), exemplary public, Shahid, and gifted schools. The total number of these students was 593. To address the research questions and examine the effectiveness of emotional self-regulation skills on the dependent variables, students were randomly selected using cluster sampling. Six schools were randomly chosen, and two classes from each school were selected. Sixty students were randomly selected and divided into one experimental group of 30 students and one control group of 30 students. The experimental group received training in emotional self-regulation skills, while the control group received no intervention. The inclusion criterion was

being a ninth-grade student in Jajrom schools, and the exclusion criterion was absence from more than three sessions.

2.2. Measures

2.2.1. Working Memory

The Daneman and Carpenter (1980) Working Memory Test comprises 27 sentences to assess the ability to determine the correctness of sentences semantically and evaluate the subject's memory (Daneman & Carpenter, 1980). In a preliminary study by Dr. Hassan Asadzadeh on 84 psychology and education students at Allameh Tabataba'i University, the reliability coefficient was 0.88 (Haqnazari et al., 2022). In this study, the reliability was calculated as 0.87 using the Kuder-Richardson method, indicating high reliability.

2.2.2. Cognitive Flexibility

Developed by Dennis and Vander Wal in 2010, this questionnaire includes 20 items and assesses progress in clinical and non-clinical settings, particularly in cognitive-behavioral therapy for depression and other mental disorders. In Iran, three subscales—alternatives, control, and alternatives for human behaviors—were identified in Sharah et al.'s (2014) study (cited in Fazeli et al., 2013). The CFI uses a 5-point Likert scale ranging from (strongly disagree: 1) to (somewhat agree: 5). Dennis and Vander Wal (2010) reported a concurrent validity of -0.39 with the Beck Depression Inventory (BDI-II) and a convergent validity of 0.75 with the Martin and Rubin Cognitive Flexibility Scale. In Iran, Sharah et al. (2013) reported a test-retest reliability of 0.71 and a Cronbach's alpha of 0.90. In Fazeli et al.'s (2013) study, Cronbach's alpha was 0.75 (Emamverdi & Taher, 2020). In this study, Cronbach's alpha for the subscales alternatives, control, and alternatives for human behaviors were 0.72, 0.55, and 0.57, respectively.

2.3. Interventions

2.3.1. Emotional Self-Regulation Training

This protocol, based on the guidelines by Allen, McHugh, and Barlow (2009) from Boston University, included the following main topics (Ashori & Najafi, 2020; Novakovic-Agopian et al., 2020):

Session 1: Introduction to Emotion Regulation Sessions and Pre-Test Implementation

Agenda: The session begins with introductions and getting acquainted with group members. This is followed by outlining the group rules and objectives, highlighting the purpose of the course, and the importance of emotion regulation. Assignment: Group members are tasked with writing down their personal goals for participating in these sessions.

Session 2: Normal and Problematic Emotions; Emotional Self-Awareness

Agenda: This session focuses on educating and introducing emotions, identifying, naming, and labeling feelings, distinguishing between different emotions, recognizing emotions in physical and psychological states, and discussing the factors that contribute to successful emotion regulation. Assignment: Members are to identify the most frequent feelings and emotions they experience in their daily interactions.

Session 3: Pathogenic Emotions and the Need for Treatment, Symptoms of Emotional Disorders, and Appropriate Treatments

Agenda: The session covers the cognitive, physiological, and behavioral consequences of emotional reactions and their interrelationships. Participants are introduced to physical, behavioral, and cognitive symptoms, psychological treatments (cognitive-behavioral), the influence of genetics and environment, and common cognitive errors. Emotion and avoidance are discussed as indicators of emotional disorders. Assignment: Members are to write down their major negative emotions and record them in the provided form.

Session 4: Interpretations

Agenda: The focus is on understanding the relationship between emotions and behavior, emotion and thought, identifying and analyzing automatic thoughts, interpretations, and behaviors, and fostering flexibility in interpretations by considering a range of possibilities. Participants are guided on how to change and revise interpretations. Assignment: Complete the self-reflection questionnaire on how to change interpretations.

Session 5: Emotion-Driven Behaviors

Agenda: Participants learn about the consequences of emotional avoidance and the importance of experiencing emotions versus suppressing them. Assignment: Complete the self-reflection questionnaire.

Session 6: Internal Confrontation and Facing Emotions

Agenda: The session reviews the previous session, focusing on emotions with an emphasis on physical sensations, conducting exposure exercises, and paying close

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attention to any avoidance behaviors, reinterpreting and reassessing emotions. Assignment: Complete the self-reflection form.

Session 7: Core Assumptions, Principles, and Beliefs

Agenda: Introduction to beliefs related to rejection and helplessness, identifying core beliefs. Assignment: Identify several core beliefs.

Session 8: Changing Core Beliefs, Final Evaluation, and Conclusion of the Educational Program

Agenda: The session involves breaking down problematic core beliefs and replacing them with new beliefs, summarizing and concluding the discussions from previous sessions, and conducting the post-test. Assignment: Summarize and complete the questionnaire (post-test).

2.4. Data Analysis

Statistical analysis employed inferential statistics. To conduct parametric tests, variables needed to be measured on an interval scale, and homogeneity of variances was required. Additionally, for repeated measures ANOVA, Mauchly's sphericity test was necessary. Before performing repeated measures ANOVA, assumptions were checked using Mauchly's test to examine the homogeneity of the variance-covariance matrices.

3. Findings and Results

The means and standard deviations of the dependent variables in this study—cognitive flexibility, and working memory—are presented for the experimental and control groups.

Table 1

The Scores on Cognitive Flexibility and Working Memory between Experimental and Control Groups in Pre-Test and Post-Test Stages

Group	Variable	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD
Experimental	Emotional Self-Regulation Skills	74.7	5.3	99.4	3.3
Control		88.9	6.7	88.9	6.7
Experimental	Cognitive Flexibility	69.3	5.4	79.1	2.6
Control		81.4	6.2	81.4	6.2
Experimental	Working Memory	57.6	5.7	80.2	3.1
Control		66.7	6.9	66.7	6.9

The results in Table 1 show that in the post-test stage, the mean score of cognitive flexibility in the experimental group increased from 69.3 to 79.1, and the mean score of working memory increased from 57.6 to 80.2. However, in the control group, the mean scores cognitive flexibility and working memory remained unchanged between the pre-test and post-test stages.

Table 2

Results of Univariate Covariance Analysis for Cognitive Flexibility in the Emotional Self-Regulation and Control Groups

Effect	Dependent Variable	SS	df	MS	F	P	Eta
Group	Post-Test Cognitive Flexibility	130.14	1	130.14	56.47	.001	.50
	Follow-Up Cognitive Flexibility	121.30	1	121.30	48.12	.001	.47

The results in Table 2 indicate that the F values for the univariate covariance analysis in the post-test (F = 56.47, P = .001) and follow-up (F = 48.12, P = .001) for cognitive flexibility are significant. To understand the nature of this difference, the adjusted means for cognitive flexibility in the emotional self-regulation and control groups are compared in Table 3.

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Table 3

Results of Bonferroni Post Hoc Test for Comparing Adjusted Means of Cognitive Flexibility in Post-Test and Follow-Up between Experimental and Control Groups

Variable	Comparison Groups	Adjusted Means	Mean Difference	SD	P
Post-Test Cognitive Flexibility	Experimental-Control	60.85 – 73.35	12.50	0.52	.001
	Control-Experimental	73.35 – 60.85	-12.50	0.52	.001
Follow-Up Cognitive Flexibility	Experimental-Control	60.50 – 70.30	9.80	0.45	.001
	Control-Experimental	70.30 – 60.50	-9.80	0.45	.001

As shown in Table 3, there is a significant difference in cognitive flexibility between the experimental and control groups in both the post-test and follow-up stages (P < .05). In other words, the experimental group exhibited higher cognitive flexibility compared to the control group in both stages.

Table 4

Results of Univariate Covariance Analysis for Working Memory in the Emotional Self-Regulation and Control Groups

Effect	Dependent Variable	SS	df	MS	F	P	Eta
Group	Post-Test Working Memory	128.17	1	128.17	52.05	.001	.46
	Follow-Up Working Memory	125.12	1	125.12	49.24	.001	.44

The results in Table 4 indicate that the F values for the univariate covariance analysis in the post-test (F = 52.05, P = .001) and follow-up (F = 49.24, P = .001) for working memory are significant.

To accurately determine the extent of the difference between the experimental and control groups in working memory, the Bonferroni test was used to compare the adjusted means. The results are reported in Table 5.

Table 5

Results of Bonferroni Post Hoc Test for Comparing Adjusted Means of Working Memory in Post-Test and Follow-Up between Experimental and Control Groups

Variable	Comparison Groups	Adjusted Means	Mean Difference	SD	P
Post-Test Working Memory	Experimental-Control	48.75 – 56.30	7.55	0.32	.001
	Control-Experimental	56.30 – 48.75	-7.55	0.32	.001
Follow-Up Working Memory	Experimental-Control	48.15 – 54.55	6.40	0.26	.001
	Control-Experimental	54.55 – 48.15	-6.40	0.26	.001

As shown in Table 5, there is a significant difference in working memory between the experimental and control groups in both the post-test and follow-up stages (P < .05). In other words, the experimental group exhibited higher working memory compared to the control group in both stages.

4. Discussion and Conclusion

The purpose of this study was to examine the effectiveness of emotional self-regulation skills training on cognitive flexibility and working memory. The results indicated that in the post-test and follow-up stages, the experimental group had significantly higher cognitive flexibility compared to the control group. Therefore, emotional self-regulation skills training significantly impacts students' cognitive flexibility. These findings are consistent with the prior (Ashori & Najafi, 2020; Deng et al., 2020; Faraj Zadeh et al., 2020; Novakovic-Agopian et al., 2020; Taghavi et al., 2021).

In explaining the results, it can be stated that emotional structures help us predict, explain, react to, and control life events. Emotions are not stored in our memory but are reactivated by evaluating situations that trigger specific emotional frameworks, leading to particular behaviors and thereby improving students' flexibility. Emotional self-regulation skills training improves interpersonal relationships and offers new solutions, helping individuals cope better with specific situations and related emotions.

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Using emotional self-regulation skills enables students to accurately identify their emotions and examine each emotion without being overwhelmed, aiming to modulate feelings without reactive and destructive behavior.

Awareness of emotions, identifying and labeling emotions, accepting negative emotions when necessary, and facing them instead of avoiding them are emotional self-regulation skills that enhance psychological flexibility (Homer et al., 2018). Training in emotional self-regulation skills, such as identifying and reconstructing dysfunctional beliefs, helps students evaluate their conditions differently, change the intensity of their emotional reactions, feel competent in controlling their emotions, and experience less distress. Emotional self-regulation training can stop rumination and worry, enabling individuals to consciously use adaptive emotion regulation strategies when facing negative emotions, manage these emotions, and engage in goal-directed behavior, thereby enhancing effective flexibility strategies and reducing ineffective ones (e.g., catastrophizing, rumination, self-blame, and blaming others).

Additionally, the present study emphasized awareness and identification of both positive and negative emotions, which helped students have a better and clearer perception of their emotions and cognitive and psychological processes, effectively managing negative emotions related to their academic processes, improving focus, and enhancing working memory. Emotional self-regulation training instills the belief that one can manage emotional and psychological self-efficacy (Sosa & Lagana, 2019). Conversely, academic decline and reduced academic motivation cause students to have low expectations of their ability to regulate academic emotions, losing problem-solving and psychological and emotional flexibility. Therefore, emotional self-regulation training helps students perceive their capability in improving their working memory.

5. Limitations & Suggestions

Limitations of this study include the sampling restricted to ninth-grade students in Jajrom, which limits the generalizability of the results. It is recommended that this method be used with diverse student and university populations. The present study's results showed that emotional self-regulation skills training positively and significantly impacts students' cognitive flexibility and working memory, increasing both. Thus, this intervention can be used to improve students' psychological flexibility and working memory.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

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

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Authors' Contributions

All authors equally contributed to this article.

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