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The Effectiveness of a Combined Metacognitive and Self-Regulated Learning Training Package on Emotion Regulation among Upper-Secondary School Students

Marieh. Esmaeili Gheshmi[1], Sakineh. Rahpeyma Aghmiuni[2*], Alireza. Mohammadi Arya[3]

[1] PhD Candidate, Department of Educational Psychology, Ki.C., Islamic Azad University, Kish, Iran
[2] Assistant Professor, Department of Psychology, Faculty of Humanities, WT.C., Islamic Azad University, Tehran, Iran
[3] Department of Preschool Education, University of Social Welfare & Rehabilitation Sciences, Tehran, Iran

*** Corresponding author email address**: s.rahpeyma@iau-tnb.ac.ir

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A B S T R A C T

Purpose: The present study aimed to determine the effectiveness of a combined metacognitive and self-regulated learning training package on emotion regulation among upper-secondary school students.

Methods and Materials: This study was conducted using a quasi-experimental pretest–posttest–follow-up design with a non-equivalent control group. The statistical population included all upper-secondary school students studying in Tehran during the 2025–2026 academic year. A total of 30 students were selected through convenience sampling and randomly assigned to an experimental group and a control group, with 15 participants in each group. The experimental group received the combined metacognitive and self-regulated learning training package, while the control group received no intervention during the same period. Data were collected using the Emotion Regulation Questionnaire developed by Gross in 2003, which assesses cognitive reappraisal and expressive suppression on a seven-point Likert scale. Data were analyzed using descriptive statistics, repeated-measures analysis of variance, and Bonferroni post hoc tests.

Findings: The results of repeated-measures analysis of variance showed significant time, group, and time × group interaction effects for cognitive reappraisal, expressive suppression, and total adaptive emotion regulation. The experimental group showed a significant increase in cognitive reappraisal from pretest to posttest and follow-up, while expressive suppression significantly decreased across the same stages. Total adaptive emotion regulation also improved significantly in the experimental group compared with the control group. Bonferroni post hoc comparisons indicated significant differences between pretest and posttest and between pretest and follow-up in the experimental group, whereas the difference between posttest and follow-up was not significant. No significant changes were observed in the control group.

Conclusion: The combined metacognitive and self-regulated learning training package was effective in improving emotion regulation among upper-secondary school students. The intervention increased students' use of cognitive reappraisal, reduced expressive suppression, and strengthened adaptive emotion regulation, with effects maintained at follow-up.

Keywords: *Metacognition; self-regulated learning; emotion regulation; cognitive reappraisal; expressive suppression; upper-secondary students.*

1. Introduction

Emotion regulation is one of the central psychological capacities required for successful adjustment during adolescence, particularly among upper-secondary school students who are simultaneously exposed to academic pressure, developmental transitions, peer comparison, identity-related concerns, and increasing expectations for independent learning. In educational contexts, students are not only expected to acquire knowledge but also to manage frustration, anxiety, disappointment, failure experiences, motivational fluctuations, and the emotional consequences of evaluation. Emotion regulation refers to the processes through which individuals monitor, modify, and manage the intensity, duration, and expression of emotional responses in accordance with situational demands and personal goals. Within this framework, adaptive strategies such as cognitive reappraisal enable students to reinterpret stressful academic situations in more constructive ways, whereas less adaptive strategies such as expressive suppression may reduce outward emotional expression without necessarily decreasing internal emotional tension. Contemporary theoretical work has emphasized that learning emotion regulation is not a passive or automatic process, but rather a trainable developmental capacity that can be shaped through practice, feedback, self-awareness, and repeated engagement with emotionally demanding situations (Wright et al., 2025). Evidence from intervention research also suggests that strengthening cognitive reappraisal can improve daily well-being and emotional functioning, especially when individuals are trained to recognize emotional triggers and deliberately transform their interpretation of stressful events (Pogrebtsova et al., 2022). In child and adolescent populations, digital and educational interventions designed to improve emotion regulation have further shown that structured training can contribute to better emotional adaptation when programs are developmentally appropriate and systematically implemented (Reynard et al., 2022). Therefore, in school settings, emotion regulation should be considered not only a psychological outcome but also a foundational condition for learning, persistence, social functioning, and academic engagement.

The importance of emotion regulation becomes more evident when considered alongside the growing body of research on self-regulated learning. Self-regulated learning refers to the active process through which students set learning goals, select strategies, monitor their progress, regulate motivation and effort, manage learning environments, evaluate outcomes, and revise future performance. From this perspective, learning is not limited to cognitive processing; rather, it includes motivational, behavioral, emotional, and metacognitive regulation. Motivation has been conceptualized as an essential component of self-regulated learning because students must sustain effort, interpret setbacks, and maintain goal-directed behavior despite obstacles (Bakhtiar & Hadwin, 2021). Reviews of the educational literature have emphasized that self-regulated learning contributes to academic development but also involves several challenges, including differences in students' prior skills, teachers' readiness, contextual constraints, and the difficulty of transferring strategies from training sessions to authentic classroom situations (Boruchovitch et al., 2023). During periods of academic stress, such as online learning or crisis-related disruptions, self-regulated learning practices may help reduce the negative impact of academic challenges on performance by strengthening planning, monitoring, and adaptive coping (Hadwin et al., 2022). In addition, research conducted during the COVID-19 period showed that psychological distress can intensify students' academic challenges, highlighting the need for interventions that address both learning regulation and emotional adaptation (Shostak et al., 2021). Accordingly, the integration of emotion regulation into self-regulated learning interventions is theoretically justified because students' ability to plan, monitor, and evaluate learning is strongly affected by how they manage anxiety, discouragement, and pressure.

Metacognition represents another core construct in the development of successful learning and emotional adaptation. Metacognition generally refers to knowledge about one's own cognitive processes and the ability to plan, monitor, control, and evaluate thinking and learning activities. In educational interventions, metacognitive training helps students become aware of how they learn, why certain strategies work or fail, and how they can adjust their behavior when they encounter difficulty. A causal model of metacognitive awareness in integrated flipped learning among Iranian medical sciences students has highlighted the importance of metacognitive awareness as a mechanism through which students become more active, reflective, and responsible learners (Seif, 2026). Similarly, theoretical and empirical work on metacognitive-based teaching has indicated that self-regulated learning theory can be effectively integrated with the teaching of higher-order thinking skills, because both require planning, strategic monitoring, reflection, and evaluation (Hamzah et al., 2023).

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In music education, a systematic review of mechanisms driving metacognition and self-regulated learning also showed that practice, reflection, feedback, and awareness of performance processes are central to the development of self-regulatory competence (Wang, 2025). Research with young children has demonstrated that metacognition-driven science education interventions can benefit self-regulated learning, suggesting that metacognitive principles can be taught even in earlier educational stages when they are translated into concrete and structured learning activities (Chen et al., 2024). Meta-analytic evidence has also examined the effectiveness of metacognition interventions in children, indicating that metacognitive instruction has educational value when it is designed in accordance with learners' developmental characteristics (Bryce et al., 2025). These findings support the assumption that metacognition and self-regulation should not be treated as separate educational capacities, but rather as complementary processes that jointly improve students' ability to understand, guide, and modify their learning and emotional responses.

The effectiveness of self-regulated learning programs has been investigated across diverse educational levels, and findings generally support the value of structured interventions. A systematic review of self-regulated learning programs in primary education reported that such programs can improve students' strategic learning behaviors when they are implemented with adequate structure and alignment with classroom practices (Olid-Luque et al., 2024). Experimental evidence from school-based training in self-regulated learning has shown both short-term and long-term effects on academic performance, suggesting that self-regulation training may produce benefits beyond immediate post-intervention improvement (Herrero et al., 2022). In vocational schools, intervention research has further shown that self-regulated learning can be promoted when students are taught to understand their learning process, define goals, and monitor their progress in applied educational contexts (Mejeh & Held, 2022). In disadvantaged school neighborhoods, teacher-conducted self-regulation interventions have been perceived by implementers and observers as useful for improving students' learning-related behaviors and classroom functioning (Cunha et al., 2023). Research on pedagogical self-regulated learning interventions has also shown that high-quality implementation depends on planned change, teacher commitment, and alignment between intervention goals and educational routines (Faith & Pyle, 2021). Moreover, interventions targeting transitions from primary to secondary education have indicated that students may benefit from structured support such as talent lessons and reflective talks, particularly when entering more demanding academic environments (Beckers et al., 2023). Dynamic assessment methodologies in preschool contexts have likewise been used to foster self-regulated learning, showing that guided assessment and feedback can support regulation even before formal adolescence (Moreira et al., 2024). Although these studies differ in age group, setting, and intervention format, they collectively indicate that self-regulated learning is responsive to educational intervention and that structured training may be particularly useful during developmental transitions.

The relevance of self-regulated learning is not limited to face-to-face classroom instruction; it has also been documented in online, distance, language, and technology-supported learning environments. Research on online learning among second-language learners has emphasized that self-regulated learning is a key factor in determining the effectiveness of online education, because students in such environments must take greater responsibility for planning, pacing, monitoring, and persistence (Yu, 2023). In massive open online courses, teaching self-regulated learning strategies to EFL students has been shown to support learners' engagement with independent digital learning environments (Dinh & Yen, 2025). Psychometric research on self-regulated learning strategies in English grammar learning has also highlighted the role of strategy use and grammar self-efficacy in language learning outcomes (Trương, 2022). Similarly, research on information literacy and English writing has indicated that perceived self-efficacy can influence students' use of self-regulated writing strategies, demonstrating the close relationship between confidence, strategy selection, and learning regulation (Xu & Wang, 2025). In mathematics education, literature has identified a key connection between the elements of self-regulated learning and mathematics performance, suggesting that planning, cognitive strategy use, and monitoring can support achievement in cognitively demanding subjects (Shaheema et al., 2023). Research on motivational beliefs, cognitive strategy use, and self-regulation has also shown that these elements are closely associated with students' learning achievement (Nurudin et al., 2023). In higher education, the development of scales to examine self-regulatory approaches to assessment and feedback further reflects the importance of students' active engagement with feedback as part of learning regulation

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(Evans et al., 2024). Studies using multimedia self-regulated learning training have additionally explored students' motivational self-systems, indicating that self-regulation interventions can influence the network of motivational and cognitive factors that shape learning behavior (Wolff et al., 2025). These findings are important for the present study because upper-secondary students increasingly encounter complex academic environments in which emotional management, cognitive strategy use, motivation, and self-efficacy operate together.

Despite the growing evidence supporting self-regulated learning and metacognition, implementation in schools remains dependent on teachers' knowledge, classroom practices, and students' readiness to use strategies independently. Research exploring teachers' knowledge and practices of self-regulated learning in China has shown that teachers play a decisive role in whether self-regulatory strategies are explicitly taught, modeled, reinforced, and transferred into everyday learning activities (Fengmei, 2023). Similarly, studies examining how much teachers know about self-regulated learning and how they encourage it in students have emphasized that teachers' conceptual understanding of self-regulation directly affects the quality of classroom support (Šašić et al., 2023). Among pedagogy students, the utilization of learning techniques and strategies has been examined in relation to implications for self-regulated learning, showing that learners often require explicit guidance to use effective strategies rather than relying on ineffective habitual methods (Seban & Urban, 2024). Technology-based work on negotiating learning goals with one's future learning-self has also demonstrated that goal negotiation and future-oriented reflection can help learners clarify desired outcomes and regulate their learning behavior (Tsiakas et al., 2022). In gifted education, underachievement has been conceptualized within a self-regulated learning framework, suggesting that even students with high ability may underperform when they lack task-dependent regulation, motivation, or strategy use (Ridgley et al., 2020). Evidence from a randomized controlled trial in structured football has also drawn attention to the relationship between self-efficacy, perceived competence, and actual performance, reminding researchers that interventions should improve not only students' confidence but also their accurate self-monitoring and reflective judgment (Aune et al., 2025). Therefore, a combined metacognitive and self-regulated learning intervention may be more comprehensive than a single-component program because it can simultaneously target awareness, strategy use, motivation, monitoring, emotional responses, and reflective evaluation.

The connection between self-regulated learning and emotion regulation is especially important for students who experience academic difficulty, low achievement, or reduced confidence. A recent study among low-achieving EFL learners reported that emotion regulation mediated the relationship between personality traits and self-regulated learning, indicating that students' capacity to regulate emotions may influence how they engage in self-regulated learning processes (Hasim & Zhao, 2025). This finding is particularly relevant for upper-secondary students because academic tasks during this stage often involve high-stakes examinations, future educational planning, and increased pressure to perform. Students who cannot regulate emotional reactions to academic stress may avoid difficult tasks, suppress emotional distress without resolving it, or interpret failure as evidence of inability. In contrast, students who receive systematic training in metacognitive and self-regulated learning strategies may become better able to identify emotional triggers, reinterpret academic difficulties, plan responses, persist in learning tasks, and evaluate their progress more realistically. Evidence comparing study skills and emotional skills groups among students with academic difficulties has shown that both cognitive-academic and emotional dimensions are relevant to students' functioning, further supporting the need for integrated programs that do not isolate learning skills from emotional development (Fabris et al., 2021). At the same time, lessons learned from intelligent tutoring systems designed to scaffold self-regulated learning show that effective support often requires multichannel attention to cognition, behavior, motivation, and affect, rather than focusing only on one narrow aspect of learning (Azevedo et al., 2022). Systematic review evidence on supporting self-regulated learning in distance learning contexts similarly demonstrates that students require explicit scaffolding to manage the demands of independent learning environments (Edisherashvili et al., 2022). Therefore, the development and evaluation of a combined metacognitive and self-regulated learning training package for upper-secondary students can address a meaningful gap in school-based intervention research by linking learning regulation with emotion regulation.

Although previous studies have provided valuable evidence regarding metacognition, self-regulated learning, motivation, academic performance, self-efficacy, and emotion regulation, fewer studies have directly examined the effectiveness of a combined metacognitive and self-

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regulated learning training package on emotion regulation among upper-secondary school students. This gap is important because adolescence is a developmental stage in which students must gradually assume greater responsibility for both their learning and their emotional responses to academic demands. A combined package may help students understand how their thoughts, emotions, goals, strategies, and behaviors interact during learning situations. Such a program can strengthen cognitive reappraisal by teaching students to reinterpret academic challenges, and it can reduce expressive suppression by encouraging more reflective and adaptive responses to emotional pressure. It can also improve students' capacity to plan, monitor, evaluate, and adjust their learning process while remaining emotionally engaged and resilient. In the context of Tehran's upper-secondary schools, where students face substantial academic expectations and transition-related pressures, examining the effectiveness of such an intervention can provide practical evidence for educational psychologists, school counselors, teachers, and curriculum planners. Therefore, the aim of the present study was to investigate the effectiveness of a combined metacognitive and self-regulated learning training package on emotion regulation among upper-secondary school students.

2. Methods and Materials

2.1. Study Design and Participants

The present study was conducted using a quasi-experimental design with a pretest–posttest–follow-up structure and a non-equivalent control group. The statistical population consisted of all upper-secondary school students studying in Tehran during the 2025–2026 academic year. From this population, 30 students were selected through convenience sampling based on the inclusion criteria and then randomly assigned to two groups: an experimental group and a control group, with 15 participants in each group. The inclusion criteria included being enrolled in the upper-secondary level, willingness to participate in the study, obtaining informed consent from students and their parents or legal guardians, and absence from concurrent psychological or educational intervention programs during the research period. The exclusion criteria included absence from more than two intervention sessions, incomplete completion of the research questionnaire, or withdrawal from participation at any stage of the study. Before the intervention, both groups completed the pretest measure of emotion regulation. The experimental group then received the combined metacognitive and self-regulated learning training package, while the control group received no intervention during this period and continued their routine educational activities. After completion of the intervention sessions, both groups completed the posttest, and a follow-up assessment was conducted after the specified follow-up interval to examine the stability of the intervention effects.

2.2. Measures

Emotion regulation was measured using the Emotion Regulation Questionnaire developed by Gross in 2003. This questionnaire consists of 10 items and assesses two major emotion regulation strategies: cognitive reappraisal and expressive suppression. Six items measure cognitive reappraisal, which refers to changing the way one thinks about an emotional situation in order to modify its emotional impact, and four items measure expressive suppression, which refers to inhibiting or reducing the outward expression of emotional responses. Each item is scored on a seven-point Likert scale ranging from 1, indicating "strongly disagree," to 7, indicating "strongly agree." Higher scores on the cognitive reappraisal subscale indicate greater use of adaptive cognitive reinterpretation strategies, whereas higher scores on the expressive suppression subscale indicate greater reliance on suppressing emotional expression. The questionnaire has been widely used in educational and psychological research, and its validity and reliability have been confirmed in previous studies. In the present study, the questionnaire was administered at the pretest, posttest, and follow-up stages, and the internal consistency of the instrument was also examined using Cronbach's alpha coefficient.

2.3. Intervention

The intervention consisted of a combined training package based on metacognition and self-regulated learning, designed specifically for upper-secondary school students. The package was implemented for the experimental group in a structured series of training sessions, while the control group did not receive any educational or psychological intervention during the same period. The content of the intervention focused on strengthening students' awareness of their own thinking processes, improving their ability to monitor and evaluate learning strategies, enhancing planning and goal-setting skills, developing self-observation and self-assessment, and helping students regulate cognitive, motivational, behavioral, and emotional aspects of learning.

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In the metacognitive component, students were trained to identify their thoughts, recognize ineffective cognitive patterns, monitor comprehension, evaluate the effectiveness of learning strategies, and revise their approaches when necessary. In the self-regulated learning component, emphasis was placed on goal setting, time management, strategic planning, self-monitoring, motivational control, help-seeking, persistence in academic tasks, and reflection on learning outcomes. Since emotion regulation was the main outcome of the study, the sessions also emphasized how metacognitive awareness and self-regulatory skills can help students recognize emotional reactions in academic situations, reinterpret stressful learning experiences, reduce impulsive emotional responses, and use more adaptive strategies when facing academic pressure, failure, or evaluation anxiety. The intervention was delivered in group format using explanation, guided discussion, practical exercises, examples from students' academic experiences, homework assignments, and session review activities.

2.4. Data Analysis

Data analysis was conducted using both descriptive and inferential statistical methods. In the descriptive section, the mean and standard deviation of emotion regulation scores and its subscales were calculated separately for the experimental and control groups at the pretest, posttest, and follow-up stages. Before conducting inferential analyses, the assumptions required for parametric tests were examined, including normality of distribution, homogeneity of variances, and homogeneity of covariance matrices where appropriate. To examine the effectiveness of the combined metacognitive and self-regulated learning training package on students' emotion regulation, repeated-measures analysis of variance was used to compare changes across the three measurement stages between the experimental and control groups. The main effects of time and group, as well as the interaction effect of time and group, were examined. When significant differences were observed, Bonferroni post hoc comparisons were used to determine the location of differences between pretest, posttest, and follow-up scores. The level of statistical significance was set at 0.05, and effect size indices were reported to determine the magnitude of the intervention effect.

3. Findings and Results

The final sample included 30 upper-secondary school students from Tehran, who were assigned to the experimental group and the control group with 15 participants in each group. The participants' age ranged from 15 to 18 years, with a total mean age of 16.23 years and a standard deviation of 0.73. In the experimental group, the mean age was 16.27 with a standard deviation of 0.70, and in the control group, the mean age was 16.20 with a standard deviation of 0.77. The independent samples t-test showed no statistically significant difference between the two groups in terms of age, indicating that the two groups were homogeneous at baseline in this demographic variable. In terms of gender distribution, the total sample included 16 female students and 14 male students; the experimental group included eight female and seven male students, and the control group included eight female and seven male students. The chi-square test showed no significant difference between the groups in gender distribution. Regarding educational grade, 14 students were studying in the tenth grade, 10 students in the eleventh grade, and six students in the twelfth grade. The distribution of educational grade was also comparable between the experimental and control groups. Therefore, the two groups were demographically similar before the implementation of the intervention, and no meaningful baseline imbalance was observed in age, gender, or educational grade.

Before conducting the main inferential analyses, the assumptions required for parametric analysis were examined. The results of the Shapiro–Wilk test indicated that the distribution of scores for cognitive reappraisal, expressive suppression, and total adaptive emotion regulation was not significantly different from normal distribution at the pretest, posttest, and follow-up stages. Levene's test also confirmed the homogeneity of variances between the experimental and control groups for all study variables across the three measurement stages. In addition, Mauchly's test of sphericity was examined for the repeated-measures factor, and the assumption of sphericity was met for the study variables. Therefore, the data were suitable for repeated-measures analysis of variance. Descriptive statistics for the study variables in the experimental and control groups across the pretest, posttest, and follow-up stages are presented in Table 1.

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Table 1

Descriptive statistics of emotion regulation components by group and measurement stage

Variable	Group	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Follow-up Mean	Follow-up SD
Cognitive reappraisal	Experimental	24.47	4.18	32.93	4.05	32.20	4.27
Cognitive reappraisal	Control	24.93	4.35	25.40	4.31	25.07	4.12
Expressive suppression	Experimental	18.73	3.31	12.20	3.08	12.73	3.16
Expressive suppression	Control	18.20	3.58	18.00	3.45	18.13	3.36
Total adaptive emotion regulation	Experimental	37.73	5.60	52.80	5.85	51.53	5.72
Total adaptive emotion regulation	Control	38.73	5.71	39.47	5.63	38.93	5.92

As shown in Table 1, the experimental and control groups had relatively similar mean scores at the pretest stage in cognitive reappraisal, expressive suppression, and total adaptive emotion regulation, which indicates that the two groups were comparable before the intervention. After the implementation of the combined metacognitive and self-regulated learning training package, the experimental group showed a clear increase in cognitive reappraisal, with the mean score rising from 24.47 at pretest to 32.93 at posttest. This improvement was largely maintained at follow-up, where the mean score remained 32.20. In contrast, the control group showed only a very small change in cognitive reappraisal across the three stages. For expressive suppression, the experimental group showed a marked reduction from 18.73 at pretest to 12.20 at posttest, and the follow-up mean of 12.73 indicated that this reduction remained relatively stable over time. However, the control group demonstrated almost no meaningful change in expressive suppression. The total adaptive emotion regulation score, calculated by combining cognitive reappraisal with the reverse-scored expressive suppression dimension, also increased substantially in the experimental group from 37.73 at pretest to 52.80 at posttest, with a follow-up mean of 51.53. This pattern suggests that the intervention improved students' adaptive emotion regulation skills and that the effect was not limited to the immediate posttest stage but was largely sustained at follow-up.

Table 2

Results of repeated-measures analysis of variance for emotion regulation components

Variable	Source of Effect	SS	df	MS	F	p	Partial η^2
Cognitive reappraisal	Time	603.20	2	301.60	47.57	< .001	.630
Cognitive reappraisal	Group	556.40	1	556.40	19.96	< .001	.416
Cognitive reappraisal	Time × Group	531.87	2	265.94	41.94	< .001	.600
Expressive suppression	Time	303.20	2	151.60	32.88	< .001	.540
Expressive suppression	Group	244.03	1	244.03	10.95	.003	.281
Expressive suppression	Time × Group	266.13	2	133.07	28.86	< .001	.507
Total adaptive emotion regulation	Time	1712.43	2	856.22	59.75	< .001	.681
Total adaptive emotion regulation	Group	1800.90	1	1800.90	35.69	< .001	.560
Total adaptive emotion regulation	Time × Group	1546.67	2	773.34	53.97	< .001	.658

The results presented in Table 2 indicate that the effect of time was statistically significant for cognitive reappraisal, expressive suppression, and total adaptive emotion regulation. This finding shows that the mean scores of the study variables changed significantly across the pretest, posttest, and follow-up stages. The group effect was also significant for all three variables, indicating that, overall, the experimental and control groups differed significantly after considering the repeated measurements. More importantly, the interaction effect of time and group was statistically significant for cognitive reappraisal, expressive suppression, and total adaptive emotion regulation. The significant time × group interaction indicates that the pattern of change across the three measurement stages was different in the experimental group compared with the control group. In other words, the observed improvements in emotion regulation cannot be attributed merely to the passage of time or repeated measurement; rather, they reflect the effect of the combined metacognitive and self-regulated learning training package. The effect sizes were also substantial. The partial eta squared value for the time × group interaction was .600 for cognitive reappraisal, .507 for expressive suppression, and .658 for total adaptive emotion regulation, indicating that the intervention had a strong effect on improving

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adaptive emotion regulation patterns among upper-secondary school students.

Table 3

Bonferroni post hoc comparisons of emotion regulation components across measurement stages

Variable	Group	Comparison	Mean Difference	SE	p	95% CI Lower	95% CI Upper
Cognitive reappraisal	Experimental	Pretest – Posttest	-8.46	0.91	< .001	-10.74	-6.18
Cognitive reappraisal	Experimental	Pretest – Follow-up	-7.73	0.88	< .001	-9.94	-5.52
Cognitive reappraisal	Experimental	Posttest – Follow-up	0.73	0.69	.512	-1.02	2.48
Cognitive reappraisal	Control	Pretest – Posttest	-0.47	0.58	1.000	-1.93	0.99
Cognitive reappraisal	Control	Pretest – Follow-up	-0.14	0.54	1.000	-1.50	1.22
Cognitive reappraisal	Control	Posttest – Follow-up	0.33	0.49	.899	-0.91	1.57
Expressive suppression	Experimental	Pretest – Posttest	6.53	0.74	< .001	4.67	8.39
Expressive suppression	Experimental	Pretest – Follow-up	6.00	0.71	< .001	4.21	7.79
Expressive suppression	Experimental	Posttest – Follow-up	-0.53	0.55	.608	-1.92	0.86
Expressive suppression	Control	Pretest – Posttest	0.20	0.46	1.000	-0.96	1.36
Expressive suppression	Control	Pretest – Follow-up	0.07	0.44	1.000	-1.04	1.18
Expressive suppression	Control	Posttest – Follow-up	-0.13	0.42	1.000	-1.19	0.93
Total adaptive emotion regulation	Experimental	Pretest – Posttest	-15.07	1.21	< .001	-18.11	-12.03
Total adaptive emotion regulation	Experimental	Pretest – Follow-up	-13.80	1.16	< .001	-16.72	-10.88
Total adaptive emotion regulation	Experimental	Posttest – Follow-up	1.27	0.93	.284	-1.07	3.61
Total adaptive emotion regulation	Control	Pretest – Posttest	-0.74	0.77	.973	-2.68	1.20
Total adaptive emotion regulation	Control	Pretest – Follow-up	-0.20	0.72	1.000	-2.01	1.61
Total adaptive emotion regulation	Control	Posttest – Follow-up	0.54	0.68	.998	-1.17	2.25

The Bonferroni post hoc comparisons presented in Table 3 provide more detailed information about the location of the significant differences across the three measurement stages. In the experimental group, cognitive reappraisal increased significantly from pretest to posttest and from pretest to follow-up, while the difference between posttest and follow-up was not statistically significant. This pattern indicates that the intervention produced a significant improvement in students' use of cognitive reappraisal and that this improvement was maintained during the follow-up period. For expressive suppression, the experimental group showed a significant decrease from pretest to posttest and from pretest to follow-up, while the difference between posttest and follow-up was not significant. This result shows that the training package reduced students' reliance on expressive suppression as a less adaptive emotion regulation strategy and that this reduction remained stable over time. The same pattern was observed for total adaptive emotion regulation. The experimental group showed a significant increase from pretest to posttest and from pretest to follow-up, whereas the posttest–follow-up difference was not statistically significant. In contrast, none of the pairwise comparisons in the control group were statistically significant for cognitive reappraisal, expressive suppression, or total adaptive emotion regulation. Overall, these findings confirm that the combined metacognitive and self-regulated learning training package was effective in improving emotion regulation among upper-secondary school students, particularly by increasing cognitive reappraisal, reducing expressive suppression, and strengthening overall adaptive emotion regulation.

4. Discussion and Conclusion

The present study aimed to examine the effectiveness of a combined metacognitive and self-regulated learning training package on emotion regulation among upper-secondary school students. The findings showed that the intervention had a significant effect on students' emotion regulation. Specifically, students in the experimental group demonstrated a significant increase in cognitive reappraisal, a significant decrease in expressive suppression, and a significant improvement in total adaptive emotion regulation from pretest to posttest. These changes were largely maintained at the follow-up stage, while the control group did not show meaningful changes across the three measurement stages. The significant time × group interaction effects indicated that the observed improvements were not attributable to repeated measurement or the passage of time, but rather to the systematic influence of the combined metacognitive and self-regulated learning training package. The large effect sizes further confirmed that the intervention had a strong practical impact on students'

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ability to regulate emotional responses in academic and developmental contexts.

The significant increase in cognitive reappraisal among students in the experimental group suggests that the combined training package helped participants reinterpret academic and emotional situations in more constructive ways. Cognitive reappraisal requires students to pause, identify the meaning they assign to an event, reconsider alternative explanations, and choose a more adaptive interpretation before emotional responses become intensified. This process is conceptually close to metacognitive monitoring because students must become aware of their thoughts and evaluate whether those thoughts are helpful, realistic, or maladaptive. The result is consistent with theoretical models emphasizing that emotion regulation can be learned through structured practice, feedback, reflection, and intentional modification of cognitive appraisal processes (Wright et al., 2025). It is also aligned with intervention evidence showing that emotion regulation training can improve cognitive reappraisal and daily emotional well-being when participants are taught to deliberately modify their interpretation of stressful situations (Pogrebtsova et al., 2022). In the present study, students were not merely told to control their emotions; rather, they were trained to recognize the cognitive and motivational processes underlying their emotional reactions. This may explain why cognitive reappraisal improved substantially after the intervention and remained stable at follow-up.

The reduction in expressive suppression is another important finding. Expressive suppression is generally considered less adaptive than cognitive reappraisal because it often occurs after emotional activation has already developed and may reduce emotional expression without resolving the internal emotional experience. In academic settings, students who rely heavily on suppression may hide anxiety, disappointment, or frustration but continue to experience internal distress, reduced concentration, and avoidance tendencies. The present intervention may have reduced suppression because it provided students with alternative strategies for understanding and managing emotional responses. Through metacognitive reflection, self-monitoring, and evaluation of learning situations, students may have learned that emotions can be regulated through reinterpretation, planning, problem-solving, and strategic coping rather than concealment. This finding is consistent with systematic evidence showing that emotion regulation interventions for children and early adolescents can strengthen adaptive regulatory capacities when the intervention is structured and developmentally suitable (Reynard et al., 2022). It also supports the view that emotional skills and study skills should not be treated as unrelated domains, since students with academic difficulties benefit when interventions address both learning behaviors and emotional functioning (Fabris et al., 2021).

The improvement in total adaptive emotion regulation can be explained through the integrated nature of the intervention. The training package combined metacognitive awareness with self-regulated learning strategies, allowing students to understand not only what they feel but also why they feel it, how their thoughts influence emotional reactions, and how their learning behavior can be adjusted in response to pressure. Self-regulated learning theory emphasizes that successful learners actively plan, monitor, control, and evaluate their cognition, motivation, behavior, and emotions (Bakhtiar & Hadwin, 2021). Therefore, when students learn to regulate learning processes, they may also become more capable of regulating emotional responses connected to academic tasks. This explanation is consistent with findings indicating that self-regulated learning practices can reduce the negative impact of academic challenges and psychological distress on academic performance, especially in demanding learning conditions (Hadwin et al., 2022). It also aligns with evidence that distress can intensify academic difficulties, suggesting that interventions should address emotional and regulatory dimensions simultaneously (Shostak et al., 2021). In this sense, the present findings support the assumption that emotion regulation can be strengthened indirectly and directly through interventions that target self-awareness, strategy use, goal setting, self-monitoring, and reflective evaluation.

The findings are also consistent with previous research demonstrating the effectiveness of self-regulated learning interventions in educational contexts. School-based self-regulation training has been shown to produce short-term and long-term improvements in academic functioning, suggesting that self-regulatory strategies can become stable when students have opportunities to practice and internalize them (Herrero et al., 2022). Similarly, intervention studies in vocational schools have indicated that self-regulated learning can be promoted when students are guided to define learning goals, monitor progress, and evaluate the effectiveness of their strategies (Mejeh & Held, 2022). Teacher-conducted self-regulation interventions in disadvantaged school neighborhoods have also been perceived as beneficial for improving students' learning-

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related behavior and classroom engagement (Cunha et al., 2023). These studies support the present results because the intervention was not limited to theoretical instruction; it involved guided discussion, exercises, homework, and reflection on real academic experiences. Such active components likely helped students transfer the training content to emotionally challenging school situations. The maintenance of improvement at follow-up also suggests that the intervention may have strengthened internal regulatory skills rather than producing only temporary posttest gains.

The role of metacognition in the effectiveness of the intervention is especially important. Metacognitive awareness enables students to observe their own thinking, identify ineffective learning and emotional patterns, and evaluate whether their responses are consistent with their goals. Research on integrated flipped learning among Iranian students has emphasized the importance of metacognitive awareness in strengthening active and reflective learning (Seif, 2026). Similarly, metacognitive-based teaching has been linked to higher-order thinking skills because students are required to plan, monitor, and evaluate their cognitive activities (Hamzah et al., 2023). Evidence from metacognition-driven science education interventions further shows that metacognitive instruction can benefit self-regulated learning when it is embedded into structured teaching practices (Chen et al., 2024). The present intervention appears to have worked through similar mechanisms. Students were helped to identify automatic thoughts in academic situations, monitor emotional reactions, and reconsider maladaptive interpretations. As a result, they became more likely to use cognitive reappraisal and less likely to rely on suppression. This interpretation is further supported by meta-analytic evidence suggesting that metacognition interventions can be effective for children when properly designed and developmentally appropriate (Bryce et al., 2025).

The findings can also be understood in relation to motivational and self-efficacy mechanisms. Self-regulated learning is closely connected to students' beliefs about their own competence, their ability to use strategies, and their confidence in managing academic tasks. Studies have shown that perceived self-efficacy influences self-regulated strategy use in writing and information literacy contexts (Xu & Wang, 2025), while research in reading comprehension has indicated that self-regulation training can improve strategy use and self-efficacy (Dermitzaki, 2025). Multimedia self-regulated learning research has also demonstrated that training may influence the motivational self-system, suggesting that regulatory interventions can reshape the relationships among motivation, cognition, and learning behavior (Wolff et al., 2025). In the present study, as students learned to set goals, monitor progress, and evaluate outcomes, they may have developed greater confidence in their ability to manage academic demands. This increased perceived control may have reduced emotional reactivity and strengthened adaptive regulation. The result is also consistent with evidence showing that motivational beliefs, cognitive strategy use, and self-regulation are connected to students' learning achievement (Nurudin et al., 2023). When students perceive themselves as more capable of influencing outcomes, academic stress may become more manageable, thereby increasing the likelihood of reappraisal and reducing the need for suppression.

The findings are particularly meaningful for upper-secondary students because this educational stage requires more autonomous learning and stronger emotional control than earlier school years. Prior studies have shown that self-regulated learning is important during educational transitions, including the movement from primary to secondary education, when students face greater academic expectations and need structured support (Beckers et al., 2023). Although the present study focused on upper-secondary students, the same principle applies: as academic demands increase, students require more sophisticated regulatory capacities. Research on self-regulated learning programs in primary education has shown that these programs can have beneficial effects when systematically implemented (Olid-Luque et al., 2024), and studies in preschool contexts have shown that self-regulation can be fostered even in early developmental stages through dynamic assessment and guided support (Moreira et al., 2024). These findings suggest that regulatory skills develop progressively and can be strengthened across educational levels. For upper-secondary students, however, the emotional stakes may be higher because academic performance is often connected to future educational and occupational pathways. Therefore, strengthening emotion regulation through metacognitive and self-regulated learning training may be particularly valuable at this stage.

The present results also support the view that teachers and educational systems play a key role in the development of students' self-regulatory and emotional capacities. Research has shown that teachers' knowledge and practices of self-regulated learning influence whether students are explicitly taught to plan, monitor, and evaluate their learning

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(Fengmei, 2023). Other studies have similarly emphasized that the degree to which teachers understand and encourage self-regulated learning affects students' opportunity to internalize these strategies (Šašić et al., 2023). Studies of pedagogy students have also indicated that learners do not always use effective learning strategies spontaneously and may require explicit instruction in how to select and apply them (Seban & Urban, 2024). Accordingly, the effectiveness of the present intervention may be attributed to its explicit and structured nature. Instead of assuming that students would naturally develop emotional and learning regulation skills, the intervention provided direct instruction, practice, and reflection. This is consistent with research showing that planned implementation is critical for high-quality delivery of pedagogical self-regulated learning interventions (Faith & Pyle, 2021). Thus, the findings suggest that schools should not view emotion regulation as separate from teaching and learning, but as a capacity that can be systematically cultivated through educational programming.

The findings also correspond with research in technology-supported, online, and independent learning environments, where self-regulation becomes especially important. Online learning studies have shown that self-regulated learning is a key factor in the effectiveness of second-language learning because students must manage time, motivation, and strategy use more independently (Yu, 2023). Teaching self-regulated learning strategies in MOOCs has similarly been shown to support EFL students' engagement with autonomous learning contexts (Dinh & Yen, 2025). Research on English grammar learning has further supported the importance of self-regulated strategies and self-efficacy in language learning (Trương, 2022). Although the present study was conducted in a school-based setting, contemporary students frequently encounter hybrid, digital, and independent learning demands. The ability to regulate emotions may therefore be essential not only in traditional classroom situations but also in technology-mediated learning contexts, where students may experience isolation, distraction, uncertainty, and reduced external structure. Intelligent tutoring research has shown that scaffolding self-regulated learning may require attention to cognitive, affective, behavioral, and motivational data (Azevedo et al., 2022), while systematic review evidence on distance learning has emphasized the importance of supporting self-regulated learning in less externally structured environments (Edisherashvili et al., 2022). These findings reinforce the educational relevance of the current intervention.

Finally, the results can be interpreted in light of the emerging evidence that emotion regulation may be a mediating mechanism linking personal characteristics and self-regulated learning. Recent research among low-achieving EFL learners showed that emotion regulation mediated the relationship between personality traits and self-regulated learning, suggesting that students' emotional regulatory capacity may influence how effectively they engage in learning regulation (Hasim & Zhao, 2025). This finding strongly supports the theoretical foundation of the present study. If emotion regulation is central to students' ability to self-regulate learning, then interventions that combine metacognitive and self-regulated learning strategies should be expected to improve emotional outcomes. The present findings also align with research showing connections between self-regulated learning and performance in mathematics (Shaheema et al., 2023), as well as with work showing that goal negotiation and future-oriented reflection can support regulation of learning goals (Tsiakas et al., 2022). Moreover, the findings are consistent with the idea that underachievement can be understood through a self-regulated learning framework, since students may fail to perform well not because of insufficient ability but because of poor regulation of effort, cognition, motivation, and emotion (Ridgley et al., 2020). Evidence from structured sport contexts also suggests that interventions should improve students' accurate self-perception and self-efficacy, because confidence without reflection may not be sufficient for adaptive functioning (Aune et al., 2025). Taken together, the findings of the present study confirm that a combined metacognitive and self-regulated learning package can improve emotion regulation by strengthening students' awareness, strategic control, reflective thinking, and adaptive interpretation of academic experiences.

One of the limitations of the present study was the relatively small sample size, which included 30 upper-secondary school students from Tehran. Although the quasi-experimental design with a control group, pretest, posttest, and follow-up assessment strengthened the internal logic of the study, the limited number of participants may restrict the generalizability of the findings to broader student populations. Another limitation was the use of convenience sampling, which may reduce representativeness and increase the possibility that participants had specific motivational or contextual characteristics that differentiated them from other students. The study also relied on self-report measurement of emotion regulation, and although the instrument was

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standardized, students' responses may have been influenced by social desirability, self-perception bias, or limited awareness of their own emotional strategies. In addition, the follow-up period was limited, and the study did not examine whether the intervention effects would remain stable over longer periods such as one semester or one academic year. Finally, contextual variables such as family climate, teacher support, academic achievement level, school environment, and prior psychological training were not deeply examined, although they may influence students' emotion regulation and responsiveness to intervention.

Future research is recommended to replicate this study with larger and more diverse samples across different cities, school types, grade levels, and socioeconomic backgrounds. Future studies can also use randomized controlled trials with stricter allocation procedures to increase internal validity and reduce potential selection bias. It would be useful to include longer follow-up periods in order to determine whether improvements in cognitive reappraisal, expressive suppression, and total adaptive emotion regulation remain stable over time. Researchers may also compare the combined metacognitive and self-regulated learning package with single-component interventions, such as metacognition-only training, self-regulated learning-only training, or emotion regulation-only training, to identify the relative contribution of each component. In addition, future studies should consider using mixed-method designs, including interviews, teacher reports, classroom observations, and academic performance indicators, to provide a more comprehensive understanding of how students apply learned strategies in real educational situations. Examining mediating variables such as academic self-efficacy, test anxiety, motivation, resilience, executive functions, and perceived academic control can also clarify the mechanisms through which the intervention improves emotion regulation.

The practical implication of the present study is that schools can use combined metacognitive and self-regulated learning training as a structured approach for improving students' emotional and academic functioning. School counselors, educational psychologists, and teachers can incorporate activities related to goal setting, planning, self-monitoring, cognitive reappraisal, reflection, and evaluation into classroom and counseling programs. Since upper-secondary students face considerable academic pressure, intervention programs should help them recognize emotional triggers, reinterpret stressful academic events, manage frustration, and choose adaptive responses rather than relying on suppression or avoidance. Teachers can also be trained to model metacognitive questioning, encourage reflective learning, provide strategy-focused feedback, and create classroom conditions in which students feel safe discussing academic difficulty and emotional pressure. In practice, such programs should be implemented regularly rather than as isolated short-term workshops, and students should be given repeated opportunities to apply the strategies to homework, examinations, classroom participation, and peer-related academic situations. Integrating these skills into the school curriculum may help students become more reflective, emotionally adaptive, and capable of managing the cognitive and emotional demands of learning.

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 study and participated in the research with informed consent.

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