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RESEARCH ARTICLE

Effects of improving metacognitive awareness on emotional regulation and concentration in high school students

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Abstract: This study aimed to develop a program to improve metacognitive awareness using acceptance and cognitive defusion training to examine its effects on emotional regulation and concentration in high school students. A total of 409 students participated in a concentration test; 45 students who received scores in the bottom 20% were divided into three groups of 15 students each: metacognitive awareness improvement, motivation reinforcement, and control. The metacognitive awareness improvement and motivation reinforcement program consisted of eight sessions each while the control group received zero intervention. Participants' negative emotionality, emotional regulation, concentration, metacognitive awareness, and learning motivation were examined thrice: pre-intervention, post-intervention, and after nine weeks of follow-up. Compared to the control group, the metacognitive awareness improvement group showed considerably higher scores post-intervention and at follow-up. Conversely, the motivation reinforcement group showed higher scores and learning motivation scores only in the post-intervention stage and only showed significantly higher concentrations at follow-up.

Keywords: metacognitive awareness, emotional regulation, concentration experience acceptance, cognitive defusion, motivation reinforcement

1 Introduction

Individuals tend to fail to maintain their typical levels of concentration in disliked tasks. However, attention deficit hyperactivity disorder (ADHD) learners with an organic deficit in concentration can frequently be observed to show appropriate attention in preferred tasks. Cognitive processes such as memory and concentration are affected by emotional states, including interest, motivation, stress, and feelings of helplessness (Wei, 2015).

Although there are individual differences, most adolescents in similar developmental contexts experience rapid physiological and psychological changes, become sensitive to the surrounding environment, and show unstable emotional states, such as being easily angered or elated by trivial things (Haugaard, 2001). Therefore, in adolescents who show concentration deficits, emotional regulation failure is more prominent (Heiligenstein et al., 1998). For adolescents, the period when concentration is most affected by emotional state, Youniss & Haynie (1992) suggests that attention should be paid to adolescents' developmental context when developing programs designed to improve or prevent concentration that can be applied in common.

Human emotion plays an essential role in survival, but unregulated emotions can sometimes interfere with our ability to fully concentrate on meaningful and valuable activities (Koole et al., 2011). Concentration is the process by which an organism selectively focuses only on necessary stimuli and excludes other unnecessary external and internal stimuli (Kirk & Chalfant, 1984). When we pay attention to specific emotional stimuli, those attentional resources are not available for other tasks, causing difficulties for the individual (Bauer & Baumeister, 2013). Therefore, the higher the learner's negative emotion, the lower their concentration, and the higher the learner's control ability, the higher the concentration (Derryberry & Rothbart, 1988; Raymond & Danny, 2000; Selby et al., 2008; Wei, 2015). Lee (2019) reported that, in a study of general adolescents, emotional regulation mediates between negative emotions and concentration, and when emotional regulation is low, negative emotions increase and concentration decreases. In addition, studies on underachievers and ADHD learners have confirmed that emotional regulation helps improve concentration and reduce impulsive behavior (Koole et al., 2011; Sethi et al., 2000). Evaluation, management, and regulation of one's emotions can minimize the

influence of emotions even when external changes cause a negative emotional situation (Koole et al., 2011; Salovey & Mayer, 1990). The concept of regulation includes "active will" and refers to the awareness or intentional control of mental activity (Granic, 2002). Therefore, regulation requires a metacognitive strategy that regulates one's emotions and behaviors according to one's will in response to external stimuli (Diaz et al., 1990; Kopp, 1989). Kopp (1989) argued that while focusing on a goal, it is possible to control the internal environment through conscious and voluntary evaluation. Further, these metacognitive strategies are acquired through learning and experience, not by innately determined or acquired through growth (Kopp, 1989). In other words, the emotional state can be controlled through training to gain conscious control of emotions (Carver & Scheier, 1990).

Piaget (1968) defined metacognition as the knowledge of one's own psychological processes. Being conscious of psychological processes can be made possible by metacognitive awareness, where someone observes their psychological content from an objective point of view (Teasdale et al., 2002). When an individual realizes that emotions are not a precise response to facts but are instead mental events that arise and disappear in the mind, this realization frees the individual from obsessing about emotions and can help them to immerse themselves in more important tasks (Teasdale et al., 2002). This approach focuses on perceptions of emotions rather than their content (Borkowski et al., 1999). Metacognitive awareness attempts to alleviate emotional problems not by eliminating negative emotions or thoughts about external stimuli; instead, these emotions are permitted, but the method of dealing with these emotions is altered (Heyes & Smith, 2005). Lee (2019) reported that the effect of negative emotions on emotional regulation varies depending on the level of metacognitive awareness. Lee (2019) also confirmed that the effect of negative emotions on emotional regulation was not significant when the metacognitive awareness level was high. However, the effect of negative emotions on emotion regulation were significant when the level of metacognitive awareness was low. These results suggest that metacognitive awareness may be an essential variable in regulating negative emotions. To this end, concentration studies have not illuminated the emotional characteristics of adolescence that differ from other developmental stages. Additionally, treatments based on metacognitive awareness have been introduced (Hayes et al., 2004; Ortner et al., 2007; Teasdale et al., 2002). Further, although it is being applied to various psychological and behavioral maladjustment, the experimental application of this to improve the concentration for adolescents is still insufficient.

Kappes and Schikowski (2013) found that, compared to students with high metacognitive awareness, students with low metacognitive awareness are more likely to show experiential avoidance of stimuli that cause negative emotions and have lower levels of concentration. During avoidance, instead of accepting unpleasant experiences, the individual focuses on escaping and altering these experiences, which can shift attention from where it should be focused. However, if the individual does not strive to avoid negative emotions but accepts these emotions, a more functional response, instead of a reflexive avoidance response, can be chosen (Kazdin, 1987). The individual can then focus on currently meaningful activities and not be consumed by one's psychological state (Pilgrim & Galizio, 1995; Wilson & Hayes, 1996).

Defusion is a form of metacognitive awareness in which an individual's thoughts and emotions are viewed not as facts but as individual events from the perspective of an impassive observer. This helps prevent the individual from reacting to constructs formed from distorted interpretations of phenomena arising in their own mind (Haas, 1994). Thus, by taking an objective, distanced view, a mood is considered only a single, insignificant mood, allowing one to avoid becoming engrossed in negative emotions (Wilson & Hayes, 1996). Moreover, metacognitive awareness is a technique that can be easily learned through practice (Flavell, 1978). Therefore, it may be a useful, long-term approach for adolescents who show concentration deficits due to emotional regulation failure.

In recent times, motivation reinforcement programs have been most frequently applied in elementary, middle, and high schools to lead behavioral changes by changing emotions. One of the functions of emotion is that the emotional state is information, which guides human behavior and synchronizes mental and physical activities (Cacioppo & Gardner, 1999). Therefore, a lack of motivation leads to decreased concentration (Pintrich & De Groot, 1990). In this context, the motivational reinforcement strategy is used to select and control the psychological state consciously.

Humans have a need and a will between the reinforcement stimulus and the behavioral response, and this need is the psychological motivation that determines the direction of human behavior (Atkinson, 1965). Behavior can be reinforced in anticipation of positive rewards to satisfy these needs but can disappear again when they are not (Bandura, 1977). Activities that

are immediately rewarding, such as games, may be easier to focus on without the learner's intentional effort because they are more likely to grab attention and induce intrinsic motivation (Yantis & Jonides, 1990). On the other hand, activities such as learning that are mandatory due to social pressure are areas where intentional control of top-down attention required (Koole et al., 2011). Motivation is an internal psychological state that simultaneously acts as a catalyst for starting an activity and invokes the will to perform the activity (Atkinson, 1965; Pintrich & Schunk, 2002; Sin, 1999), which is an emotion that can be temporary and constantly fluctuating (Cacioppo & Gardner, 1999). Motivation reinforcement strategies are a way of consciously selecting and controlling one's psychological state, which can help improve concentration and regulate negative emotions. However, it may be more beneficial for students with short-term rather than long-term goals (Locke & Latham, 2002). Given that learning is a wide-reaching, long-term process in youths' everyday lives, more long-lasting strategies are required, rather than strategies targeting temporary behavior initiation.

The objective of this study was to examine whether metacognitive awareness improvement, consisting of acceptance-defusion training, had positive effects on improving emotional regulation and concentration in adolescent learners, who are susceptible to frequent emotional changes. To this end, the effects on concentration and effect duration were compared with a motivation reinforcement group and a control group. The following hypotheses were tested:

(1) The metacognitive awareness improvement program will show longer-lasting effects on emotional regulation than the motivation reinforcement program.

(2) The metacognitive awareness improvement program will show longer-lasting effects on concentration than the motivation reinforcement program.

2 Materials and methods

2.1 Participants

The study was conducted at a high school in the humanities track in S–, Gyeonggi-do, where 409 eleventh grade students participated in a concentration test. The participants comprised 45 students with the lowest score of 20%, who understood the purpose of the study, granted consent and obtained consent from their parents, and were willing to participate in the program. This study was approved by the appropriate ethics review board.

2.2 Instruments

2.2.1 Emotional regulation

The Korean version of the Emotion Regulation Checklist was used to measure emotional regulation ability. The checklist was adapted by Un-jin (2009) from the original scale developed by Shields & Cicchetti (1997). The instrument is measured on a 5-point Likert scale, and the internal consistency coefficient for total emotional regulation ability in the present study was 0.87.

2.2.2 MAS: Metacognitive Awareness Scale

To measure metacognitive awareness, an objective questionnaire developed by Hun-jung (2005) and based on a qualitative scale created by Moore et al. (1996) was used. The scale consists of 14 items, each scored on a 5-point Likert scale. In the present study, the internal consistency coefficient was 0.71.

2.2.3 Negative emotionality scale

Negative emotionality was measured using negative emotion words developed by Sun-ho et al., (1994). The instrument uses a 5-point Likert scale, and the internal consistency coefficient in the present study was 0.91.

2.2.4 Concentration scale

Concentration was measured using a scale adapted and reconstructed by Wei (2015) from a scale originally developed by Krawietz (2007). The instrument is scored on a 5-point Likert scale and the internal consistency coefficient in the present study was 0.75.

2.2.5 Learning motivation scale

Learning motivation was measured using an instrument created by Kim (2000) to measure learning motivation among high school students. The instrument is scored on a 4-point Likert

scale, and the internal consistency coefficient in the present study was 0.76.

2.3 Programs

2.3.1 Metacognitive awareness improvement program

The metacognitive awareness improvement program was an adapted version of a program developed by Jeong-hwa & Chong-nak (2015), consisting of eight sessions in total. This was based on the technique of acceptance-defusion training from the acceptance-commitment therapy of Hayes et al. (1999).

2.3.2 Motivation reinforcement program

The researchers adapted the motivation reinforcement program from a program by En-sun (2014), consisting of eight sessions in total, and was itself built upon a program developed by Velasquez et al. (2001).

2.4 Procedure

A self-report concentration test was administered to 409 eleventh grade students; among the students in the bottom 20% of scores, 45 individuals who agreed to participate in the study were randomly allocated to a metacognitive awareness improvement group, a motivation reinforcement group, and a control group, with 15 participants in each group. All three groups underwent the same tests before starting the program (pre-intervention), immediately after the end of the program (post-intervention), and underwent follow-up tests 9 weeks after the end of the program. The metacognitive awareness improvement and motivation reinforcement programs consisted of eight sessions, at 90 minutes per session, three sessions per week. The control group did not receive any intervention. After the end of the programs, one participant in the metacognitive awareness improvement group dropped out due to disease; therefore, data from 44 participants were included in the final analysis. The pre-intervention, post-intervention, and follow-up tests consisted of metacognitive awareness, emotional regulation ability, concentration, learning motivation, and negative emotionality tests.

2.5 Analysis

Data were analyzed using SPSS 12.0. The Brown-Forsythe test was used to verify the homogeneity of the three groups before the intervention. To measure the effects of the program in each group, a repeated-measures two-way ANOVA was performed. The Bonferroni test was used for post-hoc analysis of differences between time points and groups.

3 Results

3.1 Homogeneity testing of the intervention and control groups

As shown in Table 1, there were no significant differences in pre-intervention scores between the three groups, demonstrating that the groups were homogeneous.

3.2 Changes in the pre-intervention, post-intervention, and follow-up scores of the acceptance-defusion, motivation reinforcement, and control groups

Table 2 shows the mean and standard deviation values for the pre-intervention, post-intervention, and follow-up tests in the metacognitive awareness improvement, motivation reinforcement, and control groups.

3.3 Changes in metacognitive awareness

As shown in Table 3, in the metacognitive awareness improvement group, metacognitive awareness was significantly higher post-intervention and follow-up than pre-intervention. In the motivation reinforcement group, metacognitive awareness was only significantly higher post-intervention compared to pre-intervention ($F[2, 41] = 17.331$, $p < 0.001$; $F[2, 41] = 20.531$, $p < 0.001$]. There were no significant differences between the pre-intervention, post-intervention, and follow-up time points in the control group.

When between-group differences were examined at each time point, there were no significant differences between the metacognitive awareness improvement group and the motivation

Table 1 Homogeneity test result of the metacognitive awareness improvement group, motivation strengthening group, and control group

Variable	Metacognitive awareness improvement group (n = 14)	Motivation reinforcement group (n = 15)	Control group (n = 15)	Brown-Forsythe Homogeneity Test	
	M (SD)	M (SD)	M (SD)	F	p
Meta-cognitive awareness	38.357 (3.815)	39.200 (4.212)	42.133 (4.173)	0.975	0.386
Emotional regulation	23.500 (2.955)	23.133 (3.270)	24.000 (2.268)	0.347	0.709
Concentration	9.500 (0.760)	9.600 (0.910)	9.267 (1.387)	0.390	0.680
Learning motivation Total	22.643 (3.054)	23.200 (2.883)	23.400 (2.165)	0.299	0.743
Study motivation	9.286 (1.773)	9.400 (1.502)	9.333 (1.718)	0.017	0.983
Continuous motivation	13.357 (1.906)	13.800 (3.075)	14.067 (1.163)	0.386	0.684
Negative emotionality	60.571 (5.529)	62.133 (5.718)	64.133 (6.163)	3.098	0.056

Table 2 Mean and standard deviations of before-after-follow up on metacognitive awareness improvement group, motivation reinforcement group, control group

Variable	Period	Metacognitive awareness improvement group (n = 14)		Motivation reinforcement group (n = 15)		Control group (n = 15)	
		M	SD	M	SD	M	SD
Meta-cognitive awareness	Before	38.357	(3.815)	39.200	(4.212)	41.733	(3.494)
	After	44.214	(3.965)	43.733	(4.511)	42.133	(4.172)
	Follow-up	42.359	(4.209)	39.000	(5.127)	40.267	(5.378)
Emotional regulation	Before	23.500	(2.955)	23.133	(3.270)	24.000	(2.268)
	After	27.071	(3.731)	27.533	(3.944)	24.933	(2.154)
	Follow-up	26.357	(3.153)	23.600	(2.947)	23.933	(2.344)
Concentration	Before	9.500	(0.760)	9.600	(0.910)	9.267	(1.387)
	After	10.857	(1.099)	10.800	(1.424)	9.267	(2.282)
	Follow-up	10.357	(1.216)	9.933	(1.223)	8.733	(1.033)
Learning motivation total	Before	22.643	(3.054)	23.200	(2.883)	23.400	(2.165)
	After	25.214	(3.926)	28.067	(3.535)	24.467	(2.446)
	Follow-up	23.786	(3.662)	24.800	(2.757)	23.600	(2.230)
Study motivation	Before	9.286	(1.773)	9.400	(1.502)	9.333	(1.718)
	After	10.143	(1.351)	11.867	(1.922)	10.000	(1.512)
	Follow-up	9.429	(1.555)	10.107	(1.302)	9.800	(2.007)
Continuous motivation	Before	13.357	(1.906)	13.800	(3.075)	14.067	(1.163)
	After	15.071	(3.149)	16.200	(3.052)	14.467	(1.356)
	Follow-up	14.357	(3.128)	14.333	(2.664)	13.800	(1.373)
Negative emotionality	Before	60.571	(5.529)	62.133	(5.718)	64.133	(6.163)
	After	52.571	(5.003)	54.067	(8.084)	62.533	(4.719)
	Follow-up	53.500	(4.433)	59.467	(8.501)	64.533	(5.235)

Table 3 Simple main effects of differences on periods measured and between groups of meta-cognitive awareness

Variable	Variance sources	Sums of squares	df	MS	F	p	Multiple comparisons
Meta-cognitive awareness	Period of measurement	309.409	2	154.705	17.221	0.000***	a < b, c
	Metacognitive awareness--improvement Group	218.311	2	152.927	17.331	0.000***	a < b, c
	Motivation reinforcement Group	328.19	2	251.455	20.531	0.000***	a, c < b
	Control Group	5.644	2	4.135	0.542	0.524	
	Before	232.648	2	116.324	0.975	0.386	
	After	70.946	2	35.473	1.646	0.205	
	Follow-up	34.863	2	17.431	6.550	0.003**	g1 > g2

Note: ** $p < 0.01$, *** $p < 0.001$; (a: before, b: after, c: follow-up, g1: metacognitive awareness improvement group, g2: motivation reinforcement group, g3: control group).

reinforcement group in pre -and post-intervention scores (F[2, 41] = 0.975, p = 0.386; F[2, 41] = 1.646, p = 0.205). However, the metacognitive awareness group showed significantly higher scores than the motivation reinforcement group (F[2, 41] = 6.550, $p < 0.01$]).

3.4 Changes in emotional regulation ability

As shown in Table 4, emotional regulation scores in the metacognitive awareness improvement group were significantly higher post-intervention and at follow-up compared to pre-intervention; however, in the motivational reinforcement group, only the post-intervention scores were significantly higher than the pre-intervention scores (F[2, 41] = 5.524, $p < 0.01$; F[2, 41] = 22.839, $p < 0.001$; F[2, 41] = 4.587, $p < 0.05$; F[2, 41] = 4.587, $p < 0.05$]). The control group showed no significant differences between the pre-intervention, post-intervention, and follow-up scores.

Table 4 Simple main effects of differences on periods measured and between groups of emotional regulation

Variable	Variance sources	Sums of squares	df	MS	F	p	Multiple comparisons
Emotional regulation	Period of measurement	197.515	2	98.758	18.524	0.000***	a < b
	Metacognitive awareness--improvement group	100	2	50	5.524	0.010**	a < b, c
	Motivation reinforcement group	175.244	2	87.622	22.839	0.000***	a, c < b
	Control group	9.378	2	7.113	4.587	0.057	
	Before	5.676	2	2.838	0.347	0.709	
	After	57.405	2	28.702	2.538	0.091	
	Follow-up	64.889	2	32.444	4.059	0.025*	g1 > g2

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; (a: before, b: after, c: follow-up, g1: metacognitive awareness improvement group, g2: motivation reinforcement group, g3: control group).

In terms of between-group differences, the follow-up scores for emotional regulation were significantly higher in the metacognitive awareness improvement group than in the motivation reinforcement group (F[2, 41] = 4.059, $p < 0.05$]).

3.5 Changes in concentration

As shown in Table 5, the metacognitive awareness improvement group and the motivation reinforcement group both showed significantly higher concentration scores post-intervention compared to pre-intervention. Conversely, the control group showed no significant differences between the pre-intervention, post-intervention, and follow-up scores.

Table 5 Simple main effects of differences on periods measured and between groups of concentration

Variable	Variance sources	Sums of squares	df	MS	F	p	Multiple comparisons
Concentration	Period of measurement	16.924	2	8.462	7.446	0.001**	a, c < b
	Metacognitive awareness improvement Group	13.19	2	6.595	7.518	0.003**	a < b
	Motivation reinforcement Group	11.511	2	8.159	4.499	0.035*	a < b
	Control Group	2.844	2	1.948	1.398	0.264	
	Before	35.171	2	17.585	9.233	0.000***	g1, g2 > g3
	After	24.111	2	12.056	4.223	0.021*	g1 > g3
	Follow-up	20.805	2	10.403	7.743	0.001**	g1, g2 > g3

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; (a: before, b: after, c: follow-up, g1: metacognitive awareness improvement group, g2: motivation reinforcement group, g3: control group).

When the groups were compared at each time point, the metacognitive awareness improvement group showed significantly higher post-intervention concentration scores than the control group (F[2, 41] = 4.223, $p < 0.05$), and at follow-up, the metacognitive awareness improvement and motivation reinforcement groups both showed significantly higher concentration scores than the control group (F[2, 41] = 9.233, $p < 0.001$).

3.6 Changes in learning motivation

As shown in Table 6, learning motivation showed no significant differences by time point in the metacognitive awareness improvement group or the control group (F[2, 41] = 1.856, p = 0.176; F[2, 41] = 3.460, p = 0.064). In contrast, the motivation reinforcement group showed significantly higher learning motivation in the post-intervention test (F(2, 41) = 16.710, p <

0.001). When the groups were compared at each time point, there were no significant differences between the pre- and follow-up scores (F[2, 41] = 0.299, p = 0.748; F[2, 41] = 3.460, p = 0.064). However, the post-intervention scores were significantly higher in the motivation reinforcement group than in the control group (F[2, 41] = 4.813, $p < 0.05$).

Table 6 Simple main effects of differences on periods measured and between groups of Study motivation

Variable	Variance sources	Sums of squares	df	MS	F	p	Multiple comparisons
Learning motivation total	Period of measurement	214.682	2	107.341	13.576	0.000***	a, c < b
	Metacognitive awareness improvement group	46.476	2	23.238	1.856	0.176	
	Motivation reinforcement group	257.911	2	128.956	16.710	0.000***	a, c < b
	Control group	9.644	2	6.626	3.460	0.064	
	Before	4.422	2	2.211	0.299	0.743	
	After	107.772	2	53.886	4.813	0.013*	g2 > g3
	Follow-up	8.075	2	4.037	0.472	0.627	
Study motivation	Period of measurement	45.318	2	22.659	11.113	0.000***	a, c < b
	Metacognitive awareness improvement group	5.905	2	2.952	1.236	0.307	
	Motivation reinforcement group	59.244	2	29.622	13.078	0.000***	a, c < b
	Control group	3.511	2	2.415	1.856	0.187	
	Before	0.096	2	0.048	0.017	0.983	
	After	32.098	2	16.049	6.124	0.005**	g1, g3 < g2
	Follow-up	1.234	2	0.617	0.227	0.798	
Continuous motivation	Period of measurement	63.136	2	31.568	7.042	0.001***	a, c < b

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; (a: before, b: after, c: follow-up, g1: metacognitive awareness improvement group, g2: motivation reinforce--ment group, g3: control group).

Study motivation showed no significant differences between time points in the metacognitive awareness improvement and control groups (F[2, 41] = 1.236, p = 0.307; F[2, 41] = 1.856, p = 0.187). On the other hand, the motivation reinforcement group showed significantly higher study motivation post-intervention than the pre-intervention and follow-up groups (F[2, 41] = 13.078, $p < 0.001$). When the groups were compared at each time point, the motivation reinforcement group showed significantly higher post-intervention scores compared to the metacognitive awareness improvement group or the control group (F[2, 41] = 6.124, $p < 0.01$).

Continuous motivation only showed significant differences by time point, and there was no significant interaction effect; thus, post-hoc testing was performed on measurement time points. Post-intervention scores were significantly higher than pre-intervention and follow-up scores (F[2, 41] = 7.042, $p < 0.001$).

3.7 Changes in negative emotionality

As shown in Table 7, the metacognitive awareness improvement group showed significantly higher negative emotionality scores pre-intervention than the post-intervention and follow-up; the motivation reinforcement group showed significantly higher scores only in post-intervention than the pre-intervention group (F[2, 41] = 5.485, $p < 0.023$; F[2, 41] = 6.150, $p < 0.05$). The control group showed no significant differences between the time points (F[2, 41] = 2.012, p = 0.153).

Table 7 Simple main effects of differences on periods measured and between groups of negative emotionality

Variable	Variance sources	Sums of squares	df	MS	F	p	Multiple comparisons
Negative emotionality	Period of measurement	150.924	2	89.787	5.930	0.006**	a, c < b
	Metacognitive awareness improvement group	132.333	2	97.508	5.485	0.023*	a < b, c
	Motivation reinforcement group	206.933	2	183.797	6.150	0.022*	a < b
	Control group	15.244	2	7.622	2.012	0.153	
	Before	76.842	2	38.421	1.991	0.15	
	After	124.548	2	62.274	3.487	0.040*	g1 > g3
	Follow-up	91.213	2	45.606	2.369	0.106	

Note: * $p < 0.05$; (a: before, b: after, c: follow-up, g1: metacognitive awareness improvement group, g2: motivation reinforcement group, g3: control group).

When differences between the groups were analyzed at each time point, the metacognitive

awareness improvement group showed significantly higher post-intervention scores than the control group ($F = [2, 41] = 3.487$, $p < 0.05$]).

4 Discussion

This study aimed to verify the effects of acceptance and defusion training based on metacognitive awareness and motivation reinforcement strategies based on psychological motivation to improve emotional regulation and concentration for negative emotions in high school students.

First, whereas the control group showed no changes in metacognitive awareness scores post-intervention or follow-up, the metacognitive awareness improvement and motivation reinforcement groups showed significantly higher metacognitive awareness scores post-intervention than pre-intervention. However, the metacognitive awareness improvement group maintained a significant improvement at follow-up, while the motivation reinforcement group's scores decreased back to pre-intervention levels. These results suggest that motivational reinforcement can increase metacognitive awareness, and Deci (1975) pointed out that people with intrinsic motivation can engage in their emotions through active and intentional metacognitive efforts. However, it also suggests that, compared to motivation reinforcement, acceptance-defusion training could be more effective in sustaining long-term metacognitive awareness improvements.

Second, both the metacognitive awareness improvement and motivation reinforcement groups showed significantly higher emotional regulation scores compared to pre-intervention. While the metacognitive awareness improvement group maintained this significant improvement at follow-up, the motivation reinforcement group's scores returned to pre-intervention levels. This result suggests that although motivational reinforcement is effective in emotional regulation, those who have training metacognitive awareness skills can control their emotions better in the long term. Additionally, Lee (2019) identified metacognitive awareness as a regulatory factor for negative emotionality and emotional regulation, supporting the proposition that metacognitive awareness has a longer-lasting effect on emotional regulation.

Third, whereas concentration showed no change between pre-intervention and post-intervention scores in the control group, the metacognitive awareness improvement group and the motivation reinforcement group showed significantly higher concentration scores at post-intervention and follow-up than at pre-intervention. This demonstrates that metacognitive awareness improvement and motivation reinforcement both have positive effects on concentration, suggesting that metacognitive awareness training could be a helpful strategy in future programs to improve concentration in youths. However, the findings in this study did not support the hypothesis that metacognitive awareness improvement would have longer-lasting effects on concentration than motivation reinforcement. Moreover, the follow-up tests in this study were performed just 9 weeks after the end of the program, which could be considered a relatively short-term follow-up. In future studies, it would be valuable to compare studies with longer follow-up periods.

Fourth, overall learning motivation, study motivation, and continuous motivation only showed significantly higher scores post-intervention than pre-intervention in the motivation reinforcement group. Nonetheless, these results were not maintained at follow-up. This supports the claim that motivation reinforcement can help prepare an individual mentally and invoke the will to start a target activity (Atkinson, 1965; Pintrich & Schunk, 2002; Sin, 1999), but may not help much with long-term maintenance (Nicholls, 1978).

Fifth, negative emotionality showed no changes between the pre- and post-intervention scores in the control group. However, the metacognitive awareness improvement group and the motivation reinforcement group showed significantly better scores post-intervention compared to pre-intervention. However, only the metacognitive awareness improvement group maintained a significant level of improvement at follow-up. These results demonstrate that both programs are effective in reducing negative emotionality. However, although negative emotions can be controlled while motivation is maintained, metacognitive awareness improvement has a longer-lasting effect. This is consistent with a previous report that higher metacognitive awareness was associated with lower negative emotionality (Nolen-Hoeksema et al., 1994).

One limitation of this study is that it tested the efficacy of group programs that can be used universally among youths. First, this study was limited to high school students. It will be necessary to conduct a study on a more diverse sample, including middle school students. Second, on the assumption that even learners with ADHD can properly concentrate on a preferred task, and on the assumption that intervention can be useful for all adolescent students who have decreased concentration due to other causes, the same program was applied to students who were in the lower 20% or less of the concentration test scores. Future studies will be necessary

to experiment by differentiating students who cannot concentrate due to emotional regulation problems from students with temperamental problems. Third, as sampling is performed only in a specific region and school, there is a limit to the generalization of the study due to sample bias. Future studies may require re-verification by overcoming bias within the scope of a specific region and school. Fourth, this study was conducted with students whose concentration scores were less than 20%. However, even people who usually show good concentration may be at reduced capacity in situations with severe stress and emotional problems, even if they usually show good concentration. Therefore, it will be necessary to expand the application of the test subjects.

The implications of this study are as follows. First, this study is valuable because it elucidates the variables explaining concentration in youths within a developmental context, where youths are in a period of unstable emotional change. To date, studies on youth concentration have primarily focused on individual differences. They have not taken an interest in the developmental context shared among youth. This approach can provide essential research for developing group programs to improve concentration in youths who share similar experiences from a developmental perspective. Second, it was verified that metacognitive awareness training could be helpful in the long term for emotional regulation in adolescents. There is a shortage of school-based programs that can improve concentration in youths who show characteristic emotional instability. This study provides evidence for applying more valuable programs based on metacognitive awareness as a regulatory variable for emotions affected by concentration in youth. Third, the results of this study can serve as a basis for expanding and applying training based on metacognitive awareness to subjects with insufficient concentration function due to emotional problems of various age groups.

Conflicts of interest

The author declares that there is no conflict of interest.

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