Impulsivity and Adjustment in Students with Mathematics Learning Disability: The Benefits of Emotional Self-Regulation Strategies

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Abstract: *Mathematics problems are more important than all other learning problems because all children are required to do mathematical calculations in their early years of schooling. The present study intends to examine the effectiveness of emotional self-regulation strategies on reducing impulsivity and improving adjustment in students with mathematics learning disability. In this semi experimental study, a pretest-posttest design with a control group was used. The population of this study included all male students with mathematics learning disability who studied in middle schools of Tehran City in the years 2014-2015. The sample included 40 male students with mathematics learning disability, selected through multistage cluster sampling and assigned randomly into experimental group and control group. The subjects were identified using Key Math Diagnostic Test and structured clinical interview. The research instruments used in this study included structured clinical interview, Key Math Diagnostic Test, Barrat Impulsiveness Scale, and Adjustment Student Questionnaire. Pretest and posttest were administered on both groups. The experimental group received 10 one-hour sessions of emotional self-regulation skills training, while the control group received no intervention. Multivariate analysis of variance was utilized to analyze data. The results of MANCOVA showed that emotional self-regulation skills training are effective in reducing impulsivity and improving adjustment in students with mathematics learning disability ($p \leq .001$). Regarding the level of social, emotional, and academic adjustment and impulsivity, the findings also suggest that there is a significant difference between the experimental group and the control group in posttest stage. According to the findings, emotional self-regulation skills training leads to an increase in the level of social, emotional, and academic adjustment in students with mathematics learning disability. Thus, it can be used as a suitable intervention method.*

Keywords: *Adjustment, Emotional self-regulation skills training, Impulsivity, Mathematics learning disability.*

I. Introduction

Nowadays, mathematics learning disability has attracted the attention of education experts more than before [1, 2]. According to Individuals with Disabilities Education Act (IDEA), learning disability is a dysfunction in one or many basic psychological processes which include the understanding of language and its application. This disorder appears as disability in listening, thinking, speaking, reading, writing, spelling, and performing mathematical calculations. Nevertheless, it does not include those learning problems caused by visual, auditory, and motor disabilities, mental retardation, emotional disorder, and undesirable status of environment and culture [3, 4]. Just like reading ability, mathematics ability plays an important role in human life. However, researchers believe that few studies have dealt with the psychological processes for mathematics competency or the underlying failures of mathematics disability [5, 6]. The prevalence of mathematics learning disability has been estimated as 5% to 8% [6, 7]. Students with mathematics learning disability have basic problems in verbal problem-solving skills, in distinguishing evident information in problems, in applying self-regulation and self-monitoring strategies in the process of doing assignments, and in maintaining attention till the assignment is completed [8, 9].

Learning disabilities cause problems for students in social, emotional, and academic aspects [10]. Full understanding of these problems requires attention to social, affective, and behavioral aspects of an individual's life [11, 12]. Social, emotional, and academic adjustments are among the variables that are disturbed because of

the problems of learning disabilities. Social adjustment is the individual's adjustment with his or her social environment. This adjustment can be achieved through changing one's self or one's environment. Emotional adjustment includes high mental health, satisfaction with private life, and coordination of feelings, activities, and thoughts. In other words, emotional adjustment denotes the mechanisms by which the individual achieves emotional stability [13]. Ultimately, social and emotional abilities and competencies are some of the determining factors affecting academic adjustment [14, 15]. Research shows that children and adolescents with learning disabilities have some problems in interpersonal skills [7, 16], bipolar disorder, ADHD, autism, mood disorders, and depression [17, 18], social information processing [19], social interactions and social abilities [20], high levels of social exclusion and loneliness [21], and adjustment problems [22, 23]. Research also shows that children with learning disability report high rates of academic, social, and affective problems as compared with normal children. However, these differences are neglected in schools [13, 22, 24].

Impulsivity is one of the variables that affect these students' academic process. Comprehensive definition of impulsivity can be interpreted as preference of immediate rewards, tendency toward adventurousness, seeking new senses, finding simple ways to achieve reward, lacking in perseverance to accomplish affairs, and short response time[25]. According to this definition, it is obvious that high levels of impulsivity are not useful but inefficient. For instance, impulsive people have a high tendency to experience use of psychotropic drugs [26]. Research shows that impulsivity has relationships with some personality traits such as extroversion [27], vulnerability [28], novelty seeking and monotony avoidance [29], and antisocial personality [30] and with disorders like depression, bipolar disorder, and borderline disorder [31].

New psychological methods have been applied for treating individuals diagnosed with mathematics learning disabilities [32]. Emotional self-regulation skill training is one of these methods. Self-regulation is a kind of learning in which individuals themselves begin and guide their knowledge acquisition instead of them relying on teachers, parents, or other educational factors [33, 34].

Zimmerman [34]believes that self-regulated learners begin and guide the learning processes meta-cognitively, motivationally, and behaviorally. They plan, organize, self-regulate, and self-assess their learning process in terms of meta-cognition in various stages. In terms of motivation, they evaluate themselves as competent, efficacious, and independent. In terms of behavior, they choose, create, and make environments that optimize their learning.

Although few studies have directly applied emotional self-regulation strategies training on reducing impulsivity and adjustment in students with mathematics learning disability, research provides evidence showing that self-regulation strategies can lead to improvement in performance of students diagnosed with learning disorders, both in elementary school and high school. Research also shows that these strategies can be effective on ADHD children [35]. Furthermore, research also shows the positive effects of self-regulation interventions on reducing maladaptive behaviors and increasing positive behaviors in students with learning disorders [36]. For improving self-regulation skills through verbal skills, other studies recommend that situations should be provided so that children develop relationship with others in socially accepted ways; in so doing, they can improve their self-regulation behaviors [37].

Finally, according to the psychological characteristics, behavioral problems, mood disorders (anxiety and depression), negatively affects students with mathematics learning disability [1]. Comorbidity of other mental disorders with learning disabilities, high prevalence of this disorder in students, role of emotional self-regulation skills training are key factors for success and health in these students. The research gaps in this domain and the application of the findings of the present research in pathology and treatment of patients with mathematics learning disability indicate the urgent need for the present study. Therefore, the purpose of the present study is to examine the effectiveness of emotional self-regulation strategies on reducing impulsivity and increasing adjustment in students with mathematics learning disability.

II. Materials And Methods

2.1 Research design:This is a semi experimental research with a pretest-posttest design and control group in which the effectiveness of anindependent variable (emotional self-regulation skills training) on some dependent variables (impulsivity, social, emotional, and academic adjustment).

2.1.1 Population, Sample, and Sampling method: the population of this study included all male students of secondary education in Tehran City in the years 2014-2015 who were diagnosed with mathematics learning disability. In this research, multistage cluster sampling method was utilized in a way which 15 middle schools and 10 schools were randomly selected. Then, the teachers of these schools were interviewed and the suspected cases of mathematics learning disability were introduced according to DSM-IV criteria (n=150). Then, Key Math Diagnostic Test, Barrat Impulsiveness Scale, and Adjustment Student Questionnaire were administered for them. After scoring the questionnaires, 50 students who had high score in these scales were interviewed and 40 individuals were randomly selected and put into an experimental group and a control group (each group 20

subjects). In experimental method, each group should have at least 15 members. For the sample to be a real representative of population, and for the research to have a high external validity, a sample of 40 subjects (each group 20 subjects) was considered[38].

2.1.2 Inclusion and exclusioncriteria
Using inclusion and exclusion criteria, homogeneity of the subjects was observed: a. inclusion criteria included diagnosis of mathematics learning disability according to clinical interview and Key Math Diagnostic Test, aging 12 to 16 years old, having an intelligence quotient higher than 85, not receiving any medication in time of diagnosis and in the course of research, and enjoying physical and mental health for answering the questions. b. exclusion criteria included having severe comorbid disorders such as ADHD, ODD, and depression, having an intelligence quotient lower than 85, and having an illness making the individual seek therapy.

2.2 Instruments
2.2.1 Structured Clinical Interview for DSM Disorders(SCID): SCID is a semi structured clinical interview used for diagnosing the first axis disorders based on DSM. The potential usages of SCID in mental health clinics have been examined in a research. Findings of this study show that SCID is able to guarantee a reliable diagnosis[39].

2.2.2 Key Math Diagnostic Test: Key Math Diagnostic Test has been standardized by Connolly[40, 41]. This instrument is used to determine the students' strong points and weak points in different mathematic domains. Using Cronbach's alpha, the reliability of this instrument has been calculated .80[42]. This instrument has been employed for identifying students with mathematics learning disability.

2.2.3Adjustment Student Questionnaire: This questionnaire has been developed by Singha and Sing[43]. It contains 60 items with a yes-no design that discriminates adjusted students from maladjusted students in three aspects of adjustment (social, emotional, and academic). For responses indicating adjustment, score 0 is specified; otherwise, score 1 is specified. Using split-half method and test-retest method, the reliability of this instrument has been reported respectively .95 and .93[43]. Reported the test-retest coefficient and Kuder Richardson coefficient for this questionnaire respectively .93 and .94. The validity of this instrument has been confirmed by a group of psychologists[44].

2.2.4Barrat Impulsiveness Scale: This instrument has been developed by Barrat[45]. It includes 30 items with four alternatives (never, sometimes, often, and always). This scale measures three components: motor, cognitive, and non-planning impulsiveness[46]. In a pilot study, reported Cronbach's alpha coefficient and test-retest coefficient (after one month) for this scale respectively .87 and .79. In the present study, Cronbach's alpha coefficient was calculated .80[47]. Cronbach's alpha coefficient for non-planning impulsiveness and cognitive impulsiveness was respectively calculated .74 and .72.

2.3 Procedure: After getting permission from Tehran's education organization, informed consent was obtained from trainers, students, and parents. Then, the subjects filled in the Key Math Diagnostic Test, Barrat Impulsiveness Scale, and Adjustment Student Questionnaire. The students scoring high (1.5 SD higher than mean) were identified and interviewed. Forty individuals were randomly selected out of the students with mathematics learning disability and then, they were put into a control group and an experimental group.
First, the objective of the study was stated for them and the pretest was distributed among them so that they could fill in the questionnaire carefully and completely. Then, the students diagnosed with learning disability were randomly put into experimental and control groups. The experimental group was divided into two groups so that they can be controlled better. In addition, two assistants were also employed for better control. Then, each of these experimental groups received emotional self-regulation skills group training (control group received no intervention).The intervention included 10group sessions of one-hour that were held once a week. After the training sessions, posttest was administered for both groups. Finally, the collected data was analyzed by multivariate analysis of variance (MANOVA). There were no drop-outs in experimental and control groups. Emotional Self-regulation Skills Training Package was conducted by two psychology PhD students in 10 sessions by cooperation of parents on Fridays (when the schools were closed).

2.3.1 Ethical Considerations

The subjects were assured that they can leave the study whenever they want. The confidentiality of the names, identities, and findings was also told for them. Meanwhile, the ethical issues met in this study include assuring parents about confidentiality and preparing the parents psychologically for participating in the research.

2.3.2 Pilot Study

In order to fully understand the procedures of the package and to eliminate its defects, the researchers applied the package for five male students with mathematics learning disability before applying it on the main sample. The necessary experience for administering the package was gained thanks to the developed interaction between the researchers and subjects and also the feedbacks exchanged.

2.3.3 Process of the Program

Before administering the program, students completed an intelligence test based on progressive matrices. One of the two students who were similar in intelligence quotient and also in mean score of Key Math Diagnostic Test was put into experimental group; and another one was put into control group. Then, the training program (emotional self-regulation skills training) was practically conducted in 10 sessions, with the same methods for both groups.

Table1. Emotional self-regulation skills training program

Sessions	Content	Kind of training
First	Developing relationship	creating a secure environment and identifying the students' characteristics
Second and third	Motivation	identifying the students' motivational characteristics and introducing the ways of increasing motivation
Fourth	Attention	Introducing the concept of attention as one of the most important factors effective in learning and in factors affecting learning; way of enhancing attention
Fifth	Self-efficacy	A program for enhancing self-efficacy and control in students
Sixth	Time setting	Introducing time management as one of the most important techniques for more control; and time table pattern training for students
Seventh	Summarizing and note taking	Introducing these two strategies for active involvement of student in learning and applying these strategies for improved academic achievement
Eighth	Self-monitoring	This strategy is taught for enhancing self-monitoring and active involvement of student in math learning
Ninth	Self-questioning strategies for reading comprehension	This technique is introduced for student's knowledge and their advance in studying and learning mathematics
Tenth	Training of doing exercises	Teaching some methods to students about doing different exercises such as close-ended exercises, multiple choice questions, etc. Because the aim of self-regulation training is that the students become self-reliant, the students were asked to propose some questions themselves in addition to doing exercises.

III. Findings

In order to examine the presuppositions of the statistical test, the normal distribution of the scores in posttest was analyzed by Kolmogorov–Smirnov test. Results showed that the distribution of scores for both tests was normal. Therefore, multivariate analysis of variance tests were used as inferential statistical method.

Table2. Mean score and standard deviation of adjustment and impulsivity in pretest-posttest (for both groups)

Variable	Components	Experimental				Control			
		Pre test		Past test		Pre test		Past test	
		M	SD	M	SD	M	SD	M	SD
Adjustment	**Social**	7.69	0.84	11.42	1.03	7.80	0.86	7.40	0.82
	Academic	8.36	1	12.13	1.19	8.12	0.92	7.98	0.84
	Emotional	5.88	0.77	10.15	0.98	6.11	0.79	6.09	0.78
	Adjustment total	21.93	2.05	33.7	3.75	23.22	2.45	21.71	2.01
Impulsiveness	**non-planning**	31.25	2.63	25.18	1.11	31	2	29.23	1.98
	Cognitive	20.25	1.55	14.16	0.97	19.69	1.56	19	1.23
	Motor	22.18	2.03	16.13	1.01	21.18	1.16	20.05	1.58
	Impulsiveness total	73.68	4.17	55.47	2.23	71.87	3.08	68.28	3.14

According to Table 2, mean (and standard deviation) of pretest scores for experimental group is 21.93 (and 2.05) for Adjustment and 73.68 (and 4.17) for Impulsivity. Additionally, mean (and standard deviation) of posttest scores for experimental group is 33.07 (and 3.75) for Adjustment and 55.47 (and 2.23) for Impulsivity. Mean (and standard deviation) of pretest scores for control group is 23.22 (and 2.45) for Adjustment and 71.87 (and 3.08) for Impulsivity. Additionally, mean (and standard deviation) of posttest scores for control group is 21.71 (and 2.01) for Adjustment and 68.28 (and 3.14) for Impulsivity.

Table3. Results of box's test and Levine's test (regarding the presupposition of equality of variances in two groups) for adjustment and impulsivity

Variable					Levine's test	
	Scale	DF1	DF2	F		P
Adjustment	**Social**	1	38	0.817		.257
	Academic	1	38	0.988		.112
	Emotional	1	38	0.712		.189
Impulsiveness	**non-planning**	1	38	0.165		.714
	Cognitive	1	38	1.03		.087
	Motor	1	38	0.457		.578

In order to observe the presuppositions of multivariate analysis of variance test (as a parametric test), Box's test and Levine's test were used in advance. Box's test has not been significant for any of the variables (p=.181, F=1.09, BOX=7.36). Therefore, the condition of homogeneity of variance/covariance matriceshas been met. Levine's test has not been significant for all variables. Therefore, the condition of equality of intergroup variances has also been met.

Table4. Information of the measures of MANOVA in the two groups

Test	Value	Hypothesis DF	Error DF	f	P	Eta	Sig
Pillai's Trace	.658	6	33	5.254	p≤.001	.658	**1.00**
Wilks' Lambda	.342	6	33	5.254	p≤.001	.658	**1.00**
Hotelling's Trace	16.485	6	33	5.254	p≤.001	.658	**1.00**
Roy's Largest Root	16.485	6	33	5.254	p≤.001	.658	**1.00**

According to Table 4, emotional self-regulation skills training has a significant effect on Social, Emotional, and Academic Adjustment and Impulsivity (p<.001, F (33, 6) =5.254). In other words, the hypothesis indicating that emotional self-regulation skills training helps improve social, emotional, and academic adjustment and reduce impulsivity in students with mathematics learning disability is confirmed (p<.001).

Table5. Results of multivariate analysis of covariance (MANCOVA) for scores of adjustment and impulsivity in experimental group and control group

Variable	components	SS			DF	T0MS	F	P	Eta	Sig
			G	E	T					
Adjustment	**Social**	184.265	1	33	40	184.265	68.471	p≤.001	0.44	**1.00**
	Academic	176.564	1	33	40	176.564	55.247	p≤.001	0.38	**1.00**
	emotional	203.365	1	33	40	203.365	81.654	p≤.001	0.54	**1.00**
	Adjustment total	338.652	1	33	40	338.652	172.366	p≤.001	0.48	**1.00**
Impulsiveness	**non-planning**	187.545	1	33	40	187.545	76.841	p≤.001	0.50	**1.00**
	Cognitive	216.874	1	33	40	216.874	89.211	p≤.001	0.58	**1.00**
	Motor	193.213	1	33	40	193.213	77.141	p≤.001	0.52	**1.00**
	Impulsiveness total	419.746	1	33	40	419.746	213.745	p≤.001	0.51	**1.00**

According to the results of MANOVA test, emotional self-regulation skills training has a significant effect on Adjustment (p<.001, F (33, 1) = 172.366) and Impulsivity (p<.001, F (33, 1) = 213.745). There is a significant difference between experimental group (emotional self-regulation skills training) and control group regarding the mean score of Adjustment. In other words, these findings suggest an increase in social, emotional, and academic adjustment of experimental group members as compared to control group. Also, there is a significant difference between experimental group (emotional self-regulation skills training) and control group regarding the mean score of Impulsivity. In other words, these findings suggest a reduction in Impulsivity of experimental group members as compared to the control group.The effect size is respectively .48 and .51 in Adjustment and Impulsivity; that is, 48 and 51 percent of the variance in posttest scores is relevant to emotional self-regulation skills training.

IV. Discussion

This study intends to examine the effectiveness of emotional self-regulation strategies on reducing impulsivity and increasing adjustment in students with mathematics learning disability. The findings show that the Emotional Self-regulation Skills Training has been effective on social, emotional, and academic adjustment of students with mathematics learning disability. These findings are consistent with the results of other studies such as those of [35-37] .

In justifying these findings, according to self-regulation theory, controlling oneself and the environment, and having self-control processes can help one to control different activities and processes and consequently allowing one to have a better adjustment with the environment [48]. Self-regulated learners have meta-cognitive skills and know how to guide their mental processes toward achievement and personal goals. They also act to plan, self-monitor, self-control, and self-evaluate [33, 34]. In terms of motivation, this type of learning helps the students to have adaptive beliefs and high effort that would enable them to evaluate themselves as competent, efficacious, and independent. In terms of behavior, these learners are able to choose, create, and make environments for optimized learning; and they show lower maladjustment through optimized use of source management (place, time, and teaching aids), environment management, and getting help of others (teachers, peers, and parents) [34]. Therefore, provision of educational environment and classes leading students to self-regulation plays a great role in reducing maladjustment in students.

Trainings in which self-regulation and learning are emphasized and students' efforts are supported and making mistakes (in writing, reading, and calculating) is counted as a part of learning help students more extensively. Thus, use meaningful learning and high-level strategies, consequently, also enhances self-regulation. In fact, emotional self-regulation helps students with mathematics learning disability to have a deep understanding of their emotions, weak points, strong points, needs, and impulses. It also makes them able to assess, guide, and control the events of their life and to have an insight into themselves and the surrounding environment. In this case, individual adjustability is emotionally enhanced and the individual is not dominated by negative emotions [33, 34].

Findings have also showed that Emotional Self-regulation Skills Training has decreased impulsivity in students with mathematics learning disability. These findings are consistent with other studies such as those of [25, 35]. Interpretation of the data suggested that individuals with specific learning disabilities get impulsive in different situations and their knowledge of their disorder increases their impulsivity. Consequently, these individuals will have a low control on their emotions. Therefore, emotion regulation training can play an effective role in impulse control in these individuals. This point has been put into focus in the present study. On the other hand, the higher the individual's level of emotion regulation, the more able will the individual be in facing problems and tensions related to social environment [48]. In addition, through positive behavioral changes, this feature of emotional facilitation helps the individual to more efficiently adjust to the environment and environmental stimuli. In light of emotional cognition, emotionally-regulated individuals have a proper and realistic understanding about emotions; and they become able to predict and control the emotions and stressful situations [48]. Accordingly, through the mechanisms for prediction and control and the strategies for efficient encountering, emotional cognition helps individuals improve the quality of their social relationships and achieve their desirable social adjustment [33].

Overall, preparing educational environments and programs that lead students to self-regulation will play an important role in reducing their maladjustment. Maladjustment in students with specific disabilities is significantly higher than that in normal students. Therefore, exceptional schools should instill more individual discipline and less external surveillance. Research has shown that minding the individual in decision-making and taking his life responsibilities result in self-worth, efficacy, and self-determination in dealing with the environment, which finally enhance self-regulation and intrinsic motivation in students with learning disabilities [33]. This feeling has a suitable positive effect in controlling maladaptive behaviors; and the increase in successful participation of students in class is accompanied with a decrease in disorders.

V. Limitations And Recommendations

The limitations of the present research are as follows. First, the specificity of the sample to students with mathematics learning disability limits the generalization of the results to other learning disabilities. Second, the sample included only male middle school students; and thus, this limits the generalization of the results to female students. Then, there was no follow-up group for assessing the consistency of intervention. Furthermore, the sample size was also small. Finally, not comparing the findings with findings of common CBT methods and other psychotherapies is another limitation of the study. Therefore, it is recommended that psychologists, counselors, teachers, and parents pay attention to the effectiveness of emotional self-regulation strategies on reducing impulsivity and on adjustment in students with mathematics learning disability. It also recommended that future research apply this method in larger groups, compare it with other therapeutic methods, and examine the consistency of its effects in longer follow-up periods.

VI.   Conclusion

According to the findings, emotional self-regulation skills training leads to an increase in the level of social, emotional, and academic adjustment in students with mathematics learning disability. Therefore, it can be used as a suitable intervention method.

Ethical Considerations

Ethical issues (including plagiarism, informedconsent, misconduct, data fabrication and falsification, double publication and submission, redundancy, etc.) have been completely observed by the authors.

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