

Development of an Educational Model of Emotional Regulation Based on Gross Emotional Regulation (ERT), Emotional Schema Therapy (EST), and Emotional Transformation Therapy (ETT) and its Effectiveness in Internet Addiction with Different Roles of Brain/ Behavioral Systems

Fataneh Kheiripour¹, Maryam Bahrami Hidaji^{1*}, Fatemeh Mohammadi Shirmahaleh², Zohreh Rafezi³, Mania Asgharpour¹

¹Department of Psychology, Karaj Branch, Islamic Azad University, Karaj, Iran

²Clinical Cares and Health Promotion Research Center, Karaj Branch, Islamic Azad University, Karaj, Iran

³ Clinical Psychology Department, Faculty of Psychology and Education, Allameh Tabataba'i University, Tehran, Iran

* **Corresponding author:** Maryam Bahrami Hidaji, Assistant Professor, Department of Psychology, Karaj Branch, Islamic Azad University, Karaj, Iran . Email: Bahrami_h3@yahoo.com

Received 2023 May 5; Accepted 2023 July 27.

Abstract

Background: Several studies have linked emotion regulation difficulties to Internet addiction.

Objectives: The present study aimed to develop an educational model of emotional regulation based on Gross emotional regulation (ERT), Emotional Schema Therapy (EST), and Emotional Transformation Therapy (ETT) and assess its effectiveness in internet addiction with different roles of brain/behavioral systems.

Methods: The current study employed the pretest-posttest control group quasi-experimental design with a three-month follow-up. The target population for this study consisted of all secondary school students in Islamshahr, Iran, who used the Internet in the second half of 2021. The sample size consisted of 100 subjects who were randomly selected by purposive sampling and placed in three experimental and control groups (Activation System (BAS), Inhibition System (BIS), and Fight-Fight-Freeze System (FFFS) groups). The data collection instruments included a revised questionnaire from Jackson's (2009), Reinforcement Sensitivity Theory (r-RST), and Young's Internet Addiction Test (2007). Univariate covariance analysis was performed using SPSS software (version 26).

Results: As evidenced by the obtained results, emotion regulation training reduced the Internet addiction score in the experimental group ($P=0.001$; $F=71.262$). In addition, the effect size of emotional regulation training on internet addiction was 0.811%. In addition, by controlling the pretest score, emotion regulation training reduced the internet addiction score in the experimental group ($P=0.001$; $F=71.141$).

Conclusion: Emotion regulation training for students leads to increased awareness of emotional understanding and acceptance, identification of anxiety-provoking situations, change of emotional response, and less tendency for Internet addiction.

Keywords: Brain and behavior systems, Emotional regulation, Internet addiction

1. Background

Technological development has increased rapidly in recent decades, especially in the digital world, including Internet networks (1). The growth and development of internet use have brought many benefits to our society; nonetheless, this development has caused problems related to internet addiction disorder, called the pathology of internet use (2). Excessive internet use can lead to addiction (3). The increasing growth of internet addiction and its consequences has caused this disorder to be referred to as an addiction that is more common than all behavioral addictions (4). People with Internet addiction make extensive use of the Internet, which often leads to wasting time, neglecting work, as well as fostering feelings of anger, anxiety, and depression when they do not have access to the Internet (5, 6).

Internet addiction is a specific and distinct mental disorder in the diagnosis and statistical manual of mental disorders (6). As of the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), internet addiction can

be a candidate for a class of addictions unrelated to substances, just like pathological gambling (7). People with Internet addiction also face difficulties paying attention to emotional information, labeling or differentiating emotions, and emotional settings in interpersonal relationships. These difficulties cause a person to resort to incompatible adaptive strategies when facing stressful development situations (8). Emotion regulation includes awareness and evaluation of human emotional states and further comprises processes that play a role in understanding and influencing emotions. The proper use of these strategies means avoiding any negative or unwanted experiences and controlling their emotions more effectively, even when stimuli are intense, so as not to engage in problematic Internet use (8, 9).

Emotion regulation is a unique type of self-control that involves individuals consciously or unconsciously managing their emotions and meeting the needs of their surroundings. According to Trumello et al., the manipulation of emotions comprises employing a variety of techniques, whether sufficient or ineffective, adopted by an

individual when confronting circumstances. Existing research findings point to the direct and indirect effects of emotion regulation strategies on the tendency for addictive behaviors, including Internet game addiction (8, 9). The difficulty in emotion regulation is a key contributor to psychological disorders, leading to both internalizing (e.g., depression and anxiety) and externalizing (e.g., delinquent behavior and aggression) problems (10).

Yen et al. stated that emotional data processing, emotional recognition, and emotional involvement in social interactions are of great concern to those who develop Internet addiction. Challenging circumstances often force an individual to adopt unsuitable methods for dealing with overwhelming stress in their lives (8). Research background suggests that emotional regulation plays a mediating role in negative emotions and Internet addiction among Chinese adolescents from a developmental perspective. Cognitive reappraisal demonstrated a more protective role for negative emotions, which predict Internet addiction more effectively in high school students (11).

Gioia et al. indicated that problematic Internet use might be a coping strategy to compensate for emotional regulation deficits. The lack of social support and a good parent-adolescent relationship negatively affects emotional regulation abilities, which increases the risk of developing Internet addiction (12). In another study, Yang et al. reported that people with Internet addiction have less frontal alpha symmetry. These findings revealed that Internet addiction changes people's emotion regulation patterns, disrupts the activity of the prefrontal cortex, and causes problems in emotion regulation (13). A study pinpointed that employing emotion regulation strategies can modulate neural responses associated with reward processing (such as the striatum) and promote more goal-directed decision-making (e.g., less risky choices), indicating the potential importance of emotion strategies in addictive behaviors (14).

Due to the interdependence of various aspects of human functioning on emotional regulation, effective emotional regulation results in appropriate cognitive, behavioral, and motivational reactions by adjusting a person's mental responses and evaluations (15). The findings of the research suggested that both external and internal emotion regulation significantly predict Internet addiction (16). In addition to these findings, it has been demonstrated that emotional regulation difficulties in the elevation of impulse control problems in Development of an Educational Model of Emotional regulation) DERS (predict the occurrence of Internet addiction in male participants for a period of one year (17).

A recent study using functional magnetic

resonance imaging (fMRI) revealed that two brain networks, mostly connected to the frontal regions, were positively and negatively correlated with internet addiction, suggesting their implications for cognitive control (18). Despite their contrasting findings, these studies indicate that frontal regions associated with cognitive control and inhibitions are potential preclinical markers of brain dysfunction resulting from internet addiction (19). Nie et al. noted that Internet addicts only showed inhibitory deficits in the context of exposure to words related to the Internet (20). Moreover, when describing differences between Internet addicts and the control group in beta and gamma signal power, they indicated that it is coupled with impulsivity levels. Impulsivity may be associated with excessive emotion and impaired inhibitory control (21).

Cao et al. reported that Chinese adolescents with Internet addiction) IAD (exhibited more impulsivity than controls (22). Recently, Dong et al. investigated response inhibition in people with IAD by recording event-related brain potentials during a Go/NoGo task and demonstrated that the IAD group exhibited a lower NoGo-N2 amplitude, higher NoGo-P3 amplitude, and longer NoGo-P3 peak latency than the normal group. They suggested that the IAD subjects had lower activation in the conflict detection stage than the normal group; therefore, they had to engage in more cognitive endeavors to complete the inhibition task in the late stage. In addition, the IAD exhibited less efficiency in information processing and lower cognitive control (23).

The results of a previous study suggested that behavioral brain systems are of particular importance in explaining Internet addiction, and they can play an effective role in individuals' tendency for Internet behavior involvement through loneliness and cognitive emotion regulation strategies (24). The most important goals of emotional regulation training are identifying exciting situations, awareness, and acceptance of emotions, using emotional regulation strategies that lead to adjusting the sensitivity of brain-behavioral systems, reducing emotional difficulties, and less tendency to use the Internet (25).

In the meantime, the educational approach of emotional regulation tries to provide necessary conditions during the treatment process for the person to notice his/her emotions and use adaptive strategies when faced with exciting situations. The emotional regulation-training model is an integration of such approaches as the Gross Emotional Regulation Training Model (ERS), Lee Hay's Emotional Schema Therapy (EST), and Matthew Mackey's Emotional Transformation Therapy (ETT). A wide array of studies have emphasized the importance of regulating emotions and excitement concerning internet addiction, while some have aimed to enhance emotional

control. This investigation is unique in its approach to avoiding redundant work carried out in the past on this subject.

The emotional change model aims to gradually improve the emotional well-being of young people, while also addressing the issue of internet addiction. The educational approach of emotional regulation tries to provide conditions during the treatment process so that a person realizes needs, experiences, and emotions and uses appropriate adaptive strategies when faced with exciting situations. The most important goals of emotional regulation strategies are the identification of exciting situations, awareness, and acceptance of emotions. Directing attention, cognitive re-evaluation, and efficiency of emotional regulation lead to changes in the sensitivity of brain-behavior systems and emotional responsiveness with less tendency to use the Internet.

2. Objectives

Considering the role of emotion regulation difficulty in the tendency to Internet addiction, the present study deals with differences in the effectiveness of emotional regulation in people with different brain systems. The importance of emotional difficulties in driving Internet addiction has been highlighted in past research. This study emphasizes the relationship between different neural systems in individuals and the impact of emotion regulation training on their susceptibility to internet addiction.

3. Methods

The current study employed the pretest-posttest control group quasi-experimental design with a three-month follow-up. The target population for this study consisted of all secondary school students in Islamshahr, Iran, who used the Internet in the second half of 2021. This group consisted of girls aged 15-18 years old. The sample was purposively selected from volunteers who were willing to participate in the study. In the absence of information on the mean and variance of the population, G*Power software was used to estimate the required total sample size. The parameters for this estimation were set as follows: an effect size of 0.25, a type I error rate of 0.05, a test power of 0.95, and six groups. The resulting estimate indicated that a sample size of 72 participants would be sufficient. Nonetheless, to increase the validity of the results, the sample size was increased to 103 participants, which was eventually reduced to 100 due to the withdrawal of three individuals.

Data collection instruments included the Internet Addiction Questionnaire (IAQ), Jackson's Revised Reinforcement Sensitivity Questionnaire

(r-RSQ), and Goldberg and Hiller's General Health Questionnaire (GHQ), which were distributed to 630 female senior secondary school students at Shahid Maraf Art School and Shahid Natiq Nouri High School in Islamshahr, Iran. Once the data were collected, participants whose scores on the IAQ were one standard deviation above the mean were considered for the first sample. This group included 302 cases. Following that, the r-RST scores of the remaining 302 participants were assessed. Participants whose scores on the behavioral activation system (BAS), behavioral inhibition system (BIS), and fight-flight-freeze system (FFFS) factors of the r-RST were one standard deviation above the mean were selected. This reduced the number of eligible participants to 186. In the final phase, the GHQ scores of the remaining participants were analyzed. The participants who scored above 40 were selected as the final sample. Therefore, 81 participants (whose score was <40 on the GHQ) were eliminated from the study, leaving a final number of 105 participants. It is worth mentioning that at the end of the selection process, the BIS, BAS, and FFFS groups consisted of 34, 33, and 38 students, respectively.

According to the field of study and level of education, 17 participants from the BIS group and 17 others were placed in the first and second groups, respectively. In a similar vein, 16 participants from the BAS group were assigned to the first group, while 15 were allocated to the second group. Of the FFFS participants, 19 cases were in the first group, and 19 were in the second group. The first group was subsequently designated as the control group, while the second group was designated as the experimental group. Before the independent variable was introduced, two participants from the BIS group and one from the FFFS group in the experimental group expressed their disinterest in participating in the study. Therefore, the experimental group consisted of 15, 15, and 18 participants in BAS, BIS, and FFFS groups, respectively. On the other hand, the control group consisted of 17, 16, and 19 subjects in BIS, BAS, and FFFS groups, respectively. The training of the emotion regulation protocol was conducted in this constellation. The exclusion criteria of the study included non-participation of the members of the experimental group and non-completion of the IAQ by the participants of both groups at the post-test and follow-up. It is noteworthy that the participants were selected from two different schools, signifying that the emotion regulation protocol training was conducted in groups at both schools. The training program took place over seven weeks, with each session lasting 90 minutes (Table 1). The experimental group from Shahid Marafet Art School participated on odd days, while the experimental group from Shahid Natiq Nouri

High School participated on even days.

Table1: Calculation of CVR coefficients of the designed protocol by sessions

Meeting	Options	the number of experts	CVR
First	It is necessary	8	0.001
	It is useful but not necessary	0	
	It is not necessary	0	
Second	It is necessary	7	0.75
	It is useful but not necessary	1	
	It is not necessary	0	
Third	It is necessary	8	0.001
	It is useful but not necessary	0	
	It is not necessary	0	
Fourth	It is necessary	8	0.001
	It is useful but not necessary	0	
	It is not necessary	0	
the fifth	It is necessary	8	0.001
	It is useful but not necessary	0	
	It is not necessary	0	
the sixth	It is necessary	8	0.001
	It is useful but not necessary	0	
	It is not necessary	0	
the seventh	It is necessary	8	0.001
	It is useful but not necessary	0	
	It is not necessary	0	

Groups were classified based on the results of the Internet Addiction Test (IAT) and Jackson's r-RSQ. Participants' scores in this classification phase served as pretest results. After the completion of the training course in the seventh session, the IAT and Jackson's Questionnaire were administered to the participants promptly and again three months later. At the same time, the control group also completed the same Questionnaire. In addition to descriptive statistics (central and dispersion indices), this study applied a complex mixed-design method to test the research hypotheses. The reason for this approach is that in addition to the independent variable of emotion regulation protocol training, the brain-behavior systems variable was introduced as a moderating or secondary independent variable. The data obtained from the study were first described using descriptive statistical indicators, such as mean and standard deviation. Thereafter, they were analyzed using inferential statistical tests of univariate analysis of covariance to examine the differences between the experimental and control groups in the post-test and follow-up phases. Furthermore, Mauchly's sphericity test and Bonferroni's post hoc tests were performed using SPSS software (version 26).

Revised Reinforcement Sensitivity Theory (r-RST) Questionnaire

The r-RST questionnaire developed by Jackson is based on the revised version of Gray's Reinforcement Sensitivity Theory and includes 30 items (26). This instrument explores three brain-behavior systems, including the r-BAS, r-BIS, and r-FFFS. In total, the Questionnaire includes five subscales, each containing six items. Responses are rated on a five-point Likert scale, with one indicating complete agreement and five indicating complete disagreement. Jackson using Cronbach's alpha for each system and yielded values of 0.89 for the r-BAS,

0.71 for the r-BIS, and 0.74 for the r-FFFS calculated the reliability of the Questionnaire. In addition, the Iranian version of this scale was tested for validity using factor analysis, correlations between subscales, and criterion validity methods. The Persian version of Jackson's five-factor Questionnaire showed good reliability, as evidenced by Cronbach's alphas ranging from 0.72-0.88, test-retest coefficients ranging from 0.64-0.78, and test-retest correlations ranging from 0.28-0.68 (27). Cronbach's alpha in this study was estimated at 0.72.

Internet Addiction Test (IAT)

Young's IAT is a 20-item scale developed to measure Internet addiction and its impact on various aspects of users' lives (28). In this study, the Persian translation of Young's IAT developed by Alavi et al. (29) was used. Responses are scored on a selected 5-point Likert scale (five=always, four=usually, three=most of the time, 2=sometimes, and one=seldom). The possible scores range from 20-100, and Internet users were assigned to three groups based on their scores: typical users with scores between 20 and 49, at-risk users with scores between 50 and 79, and Internet users with scores between 80 and 100 who are addicted. Higher scores represent greater dependence on the Internet, potentially leading to addictive behavior. Furthermore, three experts using the Content Validity Index (0.84) confirmed the validity of the Questionnaire, and reliability was tested by a t-test (0.88). Cronbach's alpha showed a satisfactory value (0.87) in a sample of 20 medical students during a two-week data collection period. In this study, Cronbach's alpha was 0.67.

Emotional regulation based on Gross emotional regulation (ERT), Emotional Schema Therapy (EST), Emotional Transformation Therapy (ETT)

In the preparation of the emotional regulation

training protocol, important educational and therapeutic keys have been prepared to control the excessive use of the Internet and strengthen awareness and internal effortful control for a balanced and conscious use of the Internet, which has been prepared in the form of educational materials and assignments between sessions, which include the following:

1. Practical contents in the emotional regulation protocol in Internet addiction

- Becoming aware of the role of negative emotions in activating cycles of tendency to approach the Internet

Identifying situations that cause negative emotions.

- Identifying safety behaviors in situations that provoke negative emotions, such as mobile phones and internet games, leading to the reduction of negative emotions. It is interpreted in the form of adjusting the incompatible situation.

Evaluating the advantages and disadvantages of safety behaviors

- Knowing how emotions work: knowing the differences between thought, emotion, event, and behavior

- Making a list of exciting and avoided situations

- Identifying thoughts and emotions in exciting

situations

- Overcoming the obstacles of disturbing emotions through changing thoughts and behavior

- Separation between the strong desire to act and the actions taken to control impulsive behaviors

- Identifying negative evaluations that affect emotions and positive re-evaluation for emotional self-regulation

- Applying response inhibition strategies by examining their emotional consequences

Table 2 displays CVR coefficients for individual sessions, calculated separately. Given the presence of seven professionals, a coefficient value of 0.75 was deemed appropriate. The outcomes of the table indicate that the CVR coefficients for the sessions, ranging from 0.71-0.100, confirm that the protocol-designed sessions possess satisfactory content validity. After collecting the opinion of the experts, the validity ratio of the content was calculated using the following formula.

$$CVR = \frac{n_e - N/2}{N/2}$$

Table 2: Emotional regulation training protocol

Sessions	The content of the meetings
First session: Getting to know the goals of the meetings	Purpose: to familiarize the group members with each other and start the mutual relationship between the group leader (psychologist) and the members - Expressing the necessity of emotion regulation and intervention steps Realizing that emotions are transient - Increasing emotional acceptance and tolerance of mixed emotions - Teaching emotional self-regulation through awareness of emotions, understanding, and acceptance of emotions - Labeling emotions and differentiating them from other different emotions of the first session: Tasks: identifying and naming, and labeling emotions, distinguishing between different emotions
Session 2: Select the position	Purpose: to identify emotions in an exciting context - Review the assignments of the last session - Identifying emotions in physical and psychological states in an exciting context - Becoming aware of the role of negative emotions in activating cycles of a tendency to approach the Internet - Interpersonal skills training (conversation, self-expression and conflict resolution) second session: Select position Tasks: Identify situations that provoke emotion and tendency/avoidance response
Session 3: Adjustment of position	Aim: To become aware of the role of negative emotions in activating cycles of Internet addiction - Review the assignments of the last session - Identifying situations that cause negative emotions. - Identifying safety behaviors in situations that provoke negative emotions, such as mobile phones and internet games, leads to the reduction of negative emotions. It is interpreted in the form of adjusting the incompatible situation. - Evaluating the advantages and disadvantages of safety behaviors - Behavioral activation to be replaced with situations that create more adaptive behaviors that ultimately cause less tendency to approach the Internet. - Reducing emotional vulnerability to fear, anxiety and shame through self-soothing by paying attention to feelings and expressing them in words, reducing confusion or using two-seat conversations for acceptance and tolerance Negative emotions of the third session: Adjustment of position Tasks: The group members should identify more emotions that they experience in exciting situations and tendency and avoidance responses.
Session 4: Allocation of attention	Purpose: to change attention, to direct their attention to threatening clues or to avoid them. - Review the assignments of the last session - The technique of practicing non-judgmental attention to situations reduces the evaluation aspect of rumination (mindfulness). - Distraction technique: the person's goal is to refocus on the non-emotional aspects of the situation, because distraction prevents the person from challenging anxious thoughts or taking action to solve problems. Tasks: Clarifying thoughts and painful experiences, identifying and recording disturbed emotions that cause rumination.
Session 5: Cognitive re-appraisal	Purpose: to change cognitive evaluations, the underlying assumption of this stage is that situations do not directly affect emotions, cognitive processes mediate the path between situations and emotions. We consider reappraisal as an antecedent-focused strategy that leads directly to the next goal of treatment: prevention of emotional avoidance. - Reviewing the assignments of the last session

	<ul style="list-style-type: none"> - Knowing how emotions work: knowing the differences between thought, emotion, event, and behavior - Making a list of exciting and avoided situations - Identifying thoughts and emotions in exciting situations - Overcoming the obstacles of disturbing emotions through changing thoughts and behavior - Separation between the strong desire to act and the actions taken to control impulsive behaviors - Problem-solving strategy training
	Tasks: identifying negative evaluations that affect emotions and positive re-evaluation for emotional self-regulation Purpose: to change the physiological-behavioral and experiential consequences of emotion after generating emotion - Review the assignments of the last session
Session 6: Adjustment of responses	<ul style="list-style-type: none"> - Identifying wrong assessments and their effects on emotional states - Applying response inhibition strategies by examining their emotional consequences Tasks: exposure to habituation of emotionally arousing stimulus and emotional change through cognitive re-evaluation
Session 7: Re-evaluation and Troubleshooting	Evaluation and application of the goal: re-evaluation and removal of obstacles - application of learned skills in natural environments outside the session

Data Analysis

In this research, to test the assumption of normality of data distribution, the Shapiro-Wilk index of Internet addiction for all three groups in three stages demonstrated that the Shapiro-Wilk index related to Internet addiction in the FFF behavioral brain system group in the follow-up stage ($P=0.038$) was significant. Moreover, Box's M test statistic index for the dependent variable was not significant (Box's $M=23.14$, $P=0.053$, $F=1.74$). This issue demonstrated the establishment of the assumption of homogeneity of the covariance matrices of the dependent variable. Therefore, the assumption of Sphericity was not maintained among the data. (Mauchly's Sphericity test= 0.029 , $\chi^2=293.251$, $P=0.001$, $DF=2$). Therefore, the assumption of Sphericity is rejected. As a result, the assumption of the same variances and, more precisely, the condition of homogeneity of the covariance matrix was not ensured, and it has therefore made a violation of the F statistical model. Consequently, the Greenhouse-Geisser conservative test was used as an alternative test to investigate the within-subject effects of treatment

4. Results

The group consisted of 100 female students who possessed three different brain systems with specific behaviors: behavioral activation, behavioral inhibition, and the fight-flight-freeze system (FFFS). The mean age of the female students was 15.18 ± 1.31 years in both the experimental and control groups. As illustrated in Table 3, there were four students in 10th grade, 5 in 11th grade, and 6 in 12th grade in the experimental group with the BAS. The control group included six students in 10th grade, three in 11th grade, and seven in 12th grade, all with the BAS. In the FFFS experimental group, there were six participants in 10th grade, five in 11th grade, and seven in 12th grade. The FFFS control group consisted of six participants in 10th grade, eight in 11th grade, and five in 12th grade. According to Pearson's chi-square, there was no significant difference between the groups regarding in terms of educational level.

Table 3. Demographic characteristics according to the two experimental groups and the control group

Demographic information		BIS		BAS		FFF	
		Experimental	Control	Experimental	Control	Experimental	Control
Age	15 years old	5	9	3	5	9	6
	16 years old	6	6	6	7	2	5
	17 years old	3	2	5	3	4	6
	18 years old	1	0	2	1	3	2
		$\chi^2= 2.23$; $P=0.527$		$\chi^2= 1.05$; $P=0.790$		$\chi^2= 1.13$; $P=0.770$	
Grade	the tenth	4	8	4	6	6	6
	Eleventh	8	6	5	3	5	8
	twelfth	3	3	6	7	7	5
		$\chi^2= 1.52$; $P=0.472$		$\chi^2= 0.95$; $P=0.623$		$\chi^2= 0.96$; $P=0.618$	

Table 4 shows that in all three groups, the mean scores of internet addiction in the post-test and

follow-up stages have decreased more compared to the pre-test stage.

Table 4. Mean and standard deviation of Internet addiction in sample people in groups

Measurement of steps	Groups	Mean \pm SD
Pre-test	Experimental group - BAS	45.20 \pm 5.401
	Experimental group - BIS	43.33 \pm 2.582
	Experimental group-FFF	44.07 \pm 3.634
	Control group - BAS	43.20 \pm 2.859
	Control group - BIS	43.80 \pm 3.843
	Control group - FFF	46.53 \pm 6.390

Post-test	Experimental group - BAS	36.20±2.178
	Experimental group - BIS	32.53±1.506
	Experimental group-FFF	35.40±1.183
	Control group - BAS	43.07±2.963
	Control group - BIS	43.73±4.590
	Control group - FFF	46.27±6.041
Follow-up	Experimental group - BAS	36.27±2.282
	Experimental group - BIS	32.67±1.633
	Experimental group-FFF	35.47±1.246
	Control group - BAS	43.13±2.93
	Control group - BIS	43.80±4.586
	Control group - FFF	46.33±6.008

Table 5 presents the results of univariate analysis of the covariance of Internet addiction in the experimental and control groups. By controlling the pretest score, emotion regulation training reduced the Internet addiction score in the experimental group ($P=0.001$; $F=71.262$). In addition, the effect size of emotional regulation training on internet addiction was 0.811%. Furthermore, by controlling the pretest score, emotion regulation training reduced the internet addiction score in the experimental group ($P=0.001$; $F=71.141$). Moreover, the effect size of emotional regulation training on internet addiction was 0.725%. Table 4 illustrates the results of a univariate analysis of the covariance of Internet addiction in the experimental and control groups. By controlling the pretest score, emotion regulation training reduced the Internet addiction score in the experimental group ($P=0.001$; $F=186.693$). The effect size of emotional regulation training on Internet addiction was 0.874%. The results of univariate covariance analysis of Internet addiction in the experimental and control groups demonstrated that by controlling the pretest score, emotion regulation training reduced the Internet addiction score in the experimental group ($P=0.001$; $F=110.585$). In addition, the effect size of emotional regulation training on internet addiction was 0.804%.

The analysis of the variance of repeated measurement in three stages revealed that the effects of emotion regulation training on the reduction of

Internet addiction are significant ($P=0.001$ and $F=17.317$). Bonferoni's follow-up test was used to determine which phase of internet addiction scores had significant differences. The findings pointed out that the mean difference between the pretest and post-test (intervention effect) and that of the pretest and follow-up (time effect) is more significant than the mean difference between post-test and follow-up (intervention stability effect), demonstrating that internet addiction in the post-test phase and follow-up stage is significantly affected under the training of emotion regulation. According to the results, the difference between the mean of the activation system group and the inhibition system group (2.594) is not significant, illustrating that there is no difference between the effectiveness of these two groups, and both have had a meaningful effect on the reduction of internet addiction. In addition, the difference between the two active groups with the fight-avoidance system (0.149) is not significant, pointing to a significant effect on the reduction of internet addiction. In addition, the mean difference between the inhibition test group and the three control groups (Activation = -10.610, Inhibition -10.932, and Fight-Fight-Freeze = -11.895) is more than the other two test groups, suggesting that the experimental group with inhibition system had a remarkable effect on reducing internet addiction than other experimental groups.

Table 5: The results of between-group effects of univariate covariance in internet addiction, BAS, BIS, and FFF

	Source of change	sum of squares	F	p	η^2
Internet Addiction	Group	2082.975	71.262	0.001	0.811
	Pre-exam	561.321	96.019	0.001	0.536
	Error	485.212	-	-	-
	Total	143996.000	-	-	-
BAS	Group	391.142	71.141	0.001	0.725
	Pre-exam	40.885	7.436	0.001	0.216
	error	18.449	-	-	-
	Total	47667.000	-	-	-
BIS	Group	884.321	186.693	0.001	0.874
	Pre-exam	198.774	41.964	0.001	0.608
	Error	127.893	-	-	-
	Total	44892.000	-	-	-
FFF	Group	585.94	110.585	0.001	0.804
	Pre-exam	387.741	73.127	0.001	0.730
	Error	143.063	-	-	-
	Total	51437.000	-	-	-

In Table 6, the Bonferroni post-hoc test demonstrated that the training on emotion regulation in the behavioral activation and control system category led to decreased Internet addiction

scores in respective groups while considering the pretest score a controlling factor. Consequently, the experimental group who received emotional regulation training exhibited a noteworthy decline

in Internet addiction as compared to the control group ($M = -23.70$; $P < 0.001$).

Table 6 showcases the results of follow-up test conducted by BonFerroni on Internet addiction in the inhibition and control groups. The Internet addiction score of the inhibition group showed a significant reduction after undergoing emotion regulation training, as suggested in these findings, and after taking into account their pretest outcomes. Emotional regulation training effectively reduced Internet addiction in the brain inhibition system of the experimental group (-26.87 and $P < 0.001$).

Moreover, Table 6 illustrates that emotion regulation training effectively lowered the Internet addiction score for the experimental group of the fight-flight-freeze-control system, as evidenced by the controlled pretest score. Therefore, Emotion regulation training is a successful technique in the reduction of dependence on the Internet, with the

brain's fight-avoidance-freeze mechanisms playing a significant role (experimental group - control $M = -18.91$ and $P < 0.001$).

Furthermore, the results of Table 6, along with the change of means, demonstrated that cognitive regulation training in all three groups of BIS, BAS, and FFFS brain-behavioral systems in the post-test and follow-up stages compared to the pretest reduced the mean scores of Internet addiction. Nevertheless, the mean change trend among the three behavioral brain system groups, BIS, BAS, and FFFS, in the experimental group illustrated that emotional regulation training decreased Internet addiction in all three behavioral brain system groups. Despite the implementation of the independent variable, the mean score of Internet addiction in the BIS group showed a more significant reduction compared to the other two groups of the brain-behavioral system ($BIS = -26.87$, $BAS = -23.70$, $FFFS = -18.91$).

Table 6. Bonferroni's post hoc test results for pairwise comparisons of the effect of groups and times on Internet addiction.

Variable		Times	The mean Differences	Error of the standard deviation	P-value
Time (all groups)		pre-test	17/39		
		post-test		1.27	0.001
		Follow up	16/63	1.31	0.001
Time (BIS)		pre-test	22/65		
		post-test		1.89	0.001
		Follow up	21/94	2.58	0.001
Time (BAS)		pre-test	13/77		
		post-test		2.58	0.001
		Follow up	12/79	2.17	0.001
Time (FFF)		pre-test	15/40		
		post-test		2.11	0.001
		Follow up	14/84	2.05	0.001
Time (FFFS)		pre-test	23/31		
		post-test		0/95	0.001
		Follow up	26/87	1/57	0.001
Time (FFFS)		pre-test	14/84		
		post-test		2.14	1.00
		Follow up	-0.56		
Variable		Times	The mean Differences	Error of the standard deviation	P-value
group (TOTAL)	Control	the experiment	23/31	0/95	0.001
Group (BIS)	Control	the experiment	26/87	1/57	0.001
group (BAS)	Control	the experiment	-23.70	1/71	0.001
Group (FFF)	Control	the experiment	-18.91	1.65	0.001

5. Discussion

The study aimed at the effective development of an educational model of emotional regulation based on Gross emotional regulation (ERT), Emotional Schema Therapy (EST), and Matthew Mackey's Emotional Transformation Therapy (ETT) on internet addiction with different roles of brain and behavior systems. The obtained results pointed out that individuals with an activated behavior system in the brain could overcome their Internet dependency by receiving instruction on managing emotions. This finding is congruent with the results of the studies by Eynypour et al. (6) and Yan et al. (13). The behavioral activation system corresponds with favorable reactions, which may account for this outcome. The response of the behavioral activation system is triggered by the stimuli that are associated with receiving a reward or avoiding punishment (13, 25). The arousal system, which is accountable for resolving goal conflict, is recognized for inciting positive emotions, as well as promoting enthusiastic behavior and active avoidance (30).

On the other hand, Internet addiction might result from the activation of a system in the brain that pushes people towards engaging in confrontational activities and seeking rewards. Therefore, since the use of the Internet and virtual space is also a positive motivational state, it can stimulate the activity of the behavioral activation system (27). Therefore, the emotional dimension in people who are looking for rewards and searching for novelty can provide the ground for the development of problematic behaviors and withdrawal from society through the problematic use of the Internet. This finding is in line with the results of several studies (15-17). A recent study revealed that emotion regulation techniques could effectively alter the neural reactions associated with reward processing, leading to a more focused and goal-oriented decision-making approach. The observation proposes that the successful implementation of emotional control techniques can play a vital role in diminishing the likelihood of hazardous decision-making in behaviors associated with addiction (14). Therefore, teaching emotional regulation strategies reduces the pleasure and novelty of the Internet experience, such as the pleasure of searching for content, accessing information, and joining virtual networks through alternative activities and purposeful behavior (changing attention and replacing healthy pleasurable activities (6).

The results pinpointed that emotional regulation has been effective in the reduction of internet addiction in the brain inhibition system group. The obtained result is consistent with the findings reported by Eynypour et al. (6) and Yan et al. (13),

who reported the effects of emotion regulation and brain-behavioral systems on addiction and dependence on the Internet. In explaining the obtained result, it can be stated that the high activity of the behavioral inhibition system is associated with negative emotions (25). In addition, considering the fun and flexible nature of the Internet, it can be expected that people with high sensitivity in the behavioral inhibition system will temporarily resort to the Internet to get rid of their daily psychological pressures and anxieties. In fact, resorting to the Internet is a passive coping strategy (mood change and time distortion) in the face of stress. Relieving the anxiety and mental states of the person causes positive reinforcement and makes people more inclined toward the Internet (11, 12, 17).

Keep in mind that the higher the level of the inhibition system, the more sensitive the person becomes in terms of emotional experiences, and his/her problem-solving becomes more difficult. Moreover, the possible consequence of repetition and continuation of this process can be internet addiction. This finding aligns with previous research (9, 13, 17). In emotional regulation training, a person with awareness and acceptance of negative emotions, the recognition of exciting situations, and the use of emotional regulation strategies (re-evaluation and problem-solving) will have less tendency to use the Internet (9, 13). Therefore, it is reasonable that emotional regulation training affects the reduction of Internet addiction with the role of modulating the brain's inhibitory system.

The results of Bon Feroni's follow-up test of Internet addiction in the experimental group of the fight-avoidance-freeze-control system showed that emotion regulation training reduced the Internet addiction score in the experimental group by controlling the pretest score. Therefore, emotional regulation training significantly affected the reduction of Internet addiction with the modulating role of the brain's fight-avoidance-freeze systems. This result is in agreement with the findings of previous studies that have pointed to the effects of emotion regulation on internet addiction (6, 11, 13, 15, 25).

In explaining the obtained result, it can be stated that the brain's fight-avoidance-freeze system refers to a passive response to the threats that a person experiences (12). It can be expected that people with more sensitivity in the fight-avoidance-freeze system of the brain experience more threats in their daily life. In fact, in response to these threats, they turn to avoidance coping strategies, and the vast environment of the Internet and its various tools creates a safe place for them to take refuge and become dependent on the excessive use of the Internet. This finding aligns with previous research (12, 17, 22). Therefore, teaching emotional regulation strategies makes students identify their negative emotions when faced with Internet

addiction triggers and use appropriate adaptive systems (confrontation and problem-solving) to reduce emotional difficulties.

The present study suffered from a disadvantage due to the selected statistical population. The selected group was based on the challenges encountered in the education and upbringing department in Islamshahr, as well as difficulties in implementing the project for boys in a specific age group. The lack of generalizability across groups based on demographic factors, such as gender and parental educational background, might have affected the research outcomes. The lack of capacity to control test-taking behavior involves fatigue, distraction, dishonesty, and haste. The research faced various limitations, including difficulties in collecting data from the intended subjects, sample loss occurrences, absenteeism during meetings, frequent non-attendance due to air pollution, and complications in carrying out treatment procedures. The presence of time restrictions and challenges in establishing and administering the control group led to a concise monitoring phase for the analysis. To enable a comparison of research outcomes, it is advisable to incorporate the examination of males in future studies.

To improve future research, it is recommended that similar demographic characteristics (such as gender, family economic status, parents' educational background, and field of study) should be evenly distributed among the compared groups. In addition, reproducing the study is advised. Future studies should prioritize examining the expansion and endurance of emotional regulation education for students experiencing Internet addiction, with particular attention given to the long-range monitoring phase. People's dependence on the Internet is considerably affected by their emotions. Psychologists are recommended to organize educational and therapeutic workshops highlighting emotional distress's influence on Internet addiction. These workshops should be made available to diverse age groups through such institutions as families, schools, and counseling centers. The sessions should encourage the adoption of adaptable emotional regulation methods while providing access to psychotherapy services. The sessions should encompass approaches to emotions and enhance consciousness and information about online activities and virtual networks.

6. Conclusion

Emotion regulation training for students leads to increased awareness of emotional understanding and acceptance, identification of anxiety-provoking situations, adjustment of emotional response, and less tendency to Internet addiction. Therefore, emotion regulation training increases awareness of

the role of emotions in arousal and avoidance of exciting situations and the tendency to overuse the Internet. A thorough awareness of the role of emotions in the sensitivity of behavioral brain systems to rewards, punishment, and panic by learning emotional regulation strategies (re-evaluation, attention allocation, and exposure) will have a lower tendency toward Internet addiction in the form of emotional response adjustment and behavioral brain system arousal adjustment. Therefore, it is reasonable that emotion regulation training has a stable effect on the reduction of Internet addiction with the modulating role of brain-behavioral systems.

Acknowledgments

To comply with the ethical principles of the research, the subjects received the necessary information about the research. Subjects were assured that all their information would remain confidential. Informed consent was obtained from all subjects. In the end, intensive interventions were implemented for the control group. This article was extracted from a doctoral thesis with the code of ethics IR.IAU.K.REC.1401.093.

Conflicts of interest

The authors declare that they have no conflict of interest.

References

1. Kurniasanti KS, Assandi P, Ismail RI, Nasrun MWS, Wiguna T. Internet addiction: a new addiction? . *Med. J. Indones.* 2019;**28**(1):82-91. doi:[10.13181/mji.v28i1.2752](https://doi.org/10.13181/mji.v28i1.2752).
2. Di Z, Gong X, Shi J, Ahmed HO, Nandi AK. Internet addiction disorder detection of Chinese college students using several personality questionnaire data and support vector machine. *Addict Behav Rep.* 2019;**10**:100200. doi:[10.1016/j.abrep.2019.100200](https://doi.org/10.1016/j.abrep.2019.100200). [PubMed: [31508477](https://pubmed.ncbi.nlm.nih.gov/31508477/)].
3. Bashir R, Kazmi F, Khan S, Shams S. A quantitative correlational study of parental neglect, conduct problems and social media addiction among adolescents. *PalArch's J. Archaeol. Egypt/ Egyptol.* 2021;**18**(7):2600-9.
4. Sindermann C, Sariyska R, Lachmann B, Brand M, Montag C. Associations between the dark triad of personality and unspecified/specific forms of Internet-use disorder. *J Behav Addict.* 2018;**7**(4):985-92. doi:[10.1556/2006.7.2018.114](https://doi.org/10.1556/2006.7.2018.114). [PubMed: [29302225](https://pubmed.ncbi.nlm.nih.gov/29302225/)].
5. Piri Z, Amiri Majd M, Bazzazian S, Ghamari M. The mediating role of coping strategies in the relationship of difficulties in emotion regulation with internet addiction among college students. *Intern. Med.* 2019;**26**(1):38-53. doi: [10.32598/hms.26.1.3108](https://doi.org/10.32598/hms.26.1.3108)
6. Eynypour J, Bayat M, Pashang S. Prediction of University Students' Internet Addiction Based on Brain-Behavioral Systems. *J Public Health Res.* 2021;**19**(1):85-98.
7. Potenza MN. Clinical neuropsychiatric considerations regarding nonsubstance or behavioral addictions. *Dialogues Clin Neurosci.* doi: [10.31887/DCNS.2017.19.3/mpotenza](https://doi.org/10.31887/DCNS.2017.19.3/mpotenza). [PubMed: [29302225](https://pubmed.ncbi.nlm.nih.gov/29302225/)].
8. Yeh Y-C, Chen I-H, Ahorsu DK, Ko N-Y, Chen K-L, Li P-C, et al. Measurement invariance of the drivers of COVID-19 vaccination acceptance scale: comparison between Taiwanese

- and Mainland Chinese-speaking populations. *Vaccines*. 2021;**9**(3):297. doi:10.3390/vaccines9030297. [PubMed: 33810036].
9. Trumello C, Babore A, Candelori C, Morelli M, Bianchi D. Relationship with parents, emotion regulation, and callous-unemotional traits in adolescents' Internet addiction. *Biomed Res Int*. 2018;**2018**:7914261. doi:10.1155/2018/7914261. [PubMed: 29951544].
 10. Lansing AE, Plante WY, Golshan S, Fennema-Notestine C, Thuret S. Emotion regulation mediates the relationship between verbal learning and internalizing, trauma-related and externalizing symptoms among early-onset, persistently delinquent adolescents. *Learn. Individ. Differ*. 2019;**70**:201-15. doi:10.1016/j.lindif.2017.01.014 [PubMed: 31130798].
 11. Liang L, Zhu M, Dai J, Li M, Zheng Y. The mediating roles of emotional regulation on negative emotion and internet addiction among Chinese adolescents from a development perspective. *Front. Psychiatry*. 2021;**12**:608317. doi:10.3389/fpsy.2021.608317. [PubMed: 33897485].
 12. Gioia F, Rega V, Boursier V. Problematic internet use and emotional dysregulation among young people: A literature review. *Clin Neuropsychiatry*. 2021;**18**(1):41. doi:10.36131/cnfliorteditore20210104. [PubMed: 34909019].
 13. Yan X, Gao W, Yang J, Yuan J. Emotion regulation choice in internet addiction: less reappraisal, lower frontal alpha asymmetry. *Clin EEG Neurosci*. 2022;**53**(4):278-86. doi:10.1177/155005942110564 [PubMed:34894803].
 14. Martin LN, Delgado MR. The influence of emotion regulation on decision-making under risk. *J. Cogn. Neurosci*. 2011;**23**(9):2569-81. doi:10.1162/jocn.2011.21618. [PubMed: 21254801].
 15. Desrosiers A, Vine V, Curtiss J, Klemanski DH. Observing nonreactively: A conditional process model linking mindfulness facets, cognitive emotion regulation strategies, and depression and anxiety symptoms. *J. Affect. Disord*. 2014;**165**:31-7. doi:10.1016/j.jad.2014.04.024. [PubMed:24882174].
 16. Yildiz MA. Emotion regulation strategies as predictors of internet addiction and smartphone addiction in adolescents. *J. Educ. Psychol*. 2017;**7**(1).
 17. Tsai J-K, Lu W-H, Hsiao RC, Hu H-F, Yen C-F. Relationship between difficulty in emotion regulation and internet addiction in college students: A one-year prospective study. *IJERPH*. 2020;**17**(13):4766. doi:10.3390/ijerph17134766. [PubMed: 32630720].
 18. Patil AU, Madathil D, Huang CM. Age-related and individual variations in altered prefrontal and cerebellar connectivity associated with the tendency of developing internet addiction. *Hum. Brain Mapp*. 2021;**42**(14):4525-37. doi:10.1002/hbm.25562. [PubMed: 34170056].
 19. Kuss D, Griffiths M. Internet addiction in psychotherapy: Springer; 2014.
 20. Nie J, Zhang W, Chen J, Li W. Impaired inhibition and working memory in response to internet-related words among adolescents with internet addiction: A comparison with attention-deficit/hyperactivity disorder. *Psychiatry Res*. 2016;**236**:28-34. doi:10.1016/j.psychres.2016.01.004. [PubMed: 26778632].
 21. Cudo A, Zabielska-Mendyk E. Cognitive functions in Internet addiction—a review. *Psychiatr Pol*. 2019;**53**(1):61-79. doi:10.12740/PP/82194. [PubMed: 31008465].
 22. Cao F, Su L. Internet addiction among Chinese adolescents: prevalence and psychological features. *Child Care Health Dev*. 2007;**33**(3):275-81. doi:10.1111/j.1365-2214.2006.00715.x. [PubMed: 17439441].
 23. Dong G, Zhou H. Is impulse-control ability impaired in people with internet addiction disorder: electrophysiological evidence from ERP studies. *Int. J. Psychophysiol*. 2010;**3**(77):334-5. doi:10.1016/j.neulet.2010.09.002. [PubMed: 20833229].
 24. Hasani A. The Relationship between Brain Behavioral Systems and Internet Addiction with Mediating Role of Loneliness and Cognitive Emotion Regulation Strategies. *Soc. Cogn*. 2016;**5**(2):26-51. doi:10.1001.1.23223782.1395.5.2.2.4
 25. Jafari R, Ahmadi E. The Relationship between Behavioral and Metacognitive Brain Systems Sensitivity and Emotion Regulation in Heart Failure Patients. *Neurosci. J. Shafaye Khatam*. 2021;**9**(4):31-40. doi:10.52547/shefa.9.4.31.
 26. Jackson CJ. Jackson-5 scales of revised Reinforcement Sensitivity Theory (r-RST) and their application to dysfunctional real world outcomes. *J Res Pers*. 2009;**43**(4):556-69. doi:10.1016/j.jrp.2009.02.007.
 27. Fayazi M, Hasani J, Mohammadkhani S. The Role of Brain-Behavioral Systems in Internet Addiction: With Regard to Revised Reinforcement Sensitivity Theory. *J IUMS*. 2016;**24**(2):119-29.
 28. Young KS. Internet addiction: The emergence of a new clinical disorder. *Cyberpsychol Behav*. 2009;**1**(3). doi:10.1089/cpb.1998.1.237
 29. Alavi S. Psychometric properties of Young internet addiction test. *IJBS*. 2010;**4**(3):183-9.
 30. Liu RT, Burke TA, Abramson LY, Alloy LB. The behavioral approach system (BAS) model of vulnerability to bipolar disorder: Evidence of a continuum in BAS sensitivity across adolescence. *J. Abnorm. Child Psychol*. 2018;**46**:1333-49. doi:10.1007/s10802-017-0363-9. [PubMed: 29101589].