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Comparing the Effectiveness of Transcranial Direct Current Stimulation (tDCS), Cognitive Behavioral Therapy (CBT) on Students' Test Anxiety

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Abstract

This study was carried out aimed to compare the effectiveness of transcranial Direct Current Stimulation (tDCS) and Cognitive Behavioral Therapy (CBT) on elementary and secondary school students' test-anxiety in Baladeh. This study was a semi-experimental research with control group pretest-posttest design. In this study, statistical population included all the male and female elementary and secondary school students for academic year 2019-2020 in Baladeh (N=200), among which 45 students who earned a score lower than 40 were randomly selected and randomly assigned into two experimental and one control group (15 subjects in each group). Test anxiety Scale (FTAS) by Friedman & Bendas Jacob (1997) was used to collect data during two pre-test and post-test stages. First and second experimental groups received transcranial direct current stimulation and cognitive behavioral therapy, respectively, but the control group did not receive any treatment. According to the results of the ANCOVA, there was a significant difference between the test anxiety scores earned by the subjects of three groups in posttest. It can be concluded that transcranial direct current stimulation and Cognitive behavioral Therapy has had a significant effect on reducing test anxiety, and Cognitive behavioral Therapy had more significant effect than transcranial direct current stimulation on reducing students' test anxiety.

Keywords: Transcranial direct current stimulation; Cognitive behavioral therapy; Test anxiety

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Introduction

Exams and tests are considered as an integral part of people's life. The results of tests affect all aspects of life significantly [1]. One of the common educational problems is test anxiety that students face, which affects their learning and academic achievement. Test anxiety is defined as a type of self-obsession that manifests itself through self-concept and doubt, and generally causes negative cognitive assessment, lack of concentration, adverse physiological reactions, and decline in students' academic performance [2].

They have defined test anxiety as a set of behavioral, physiological, and phenomenological responses that is associated with worry about possible negative consequences or failure in a test or similar assessment situation [3]. Soysa & Weiss (2014) [4] have defined test anxiety as a form of self-obsession that is associated with self-deprecation[1], atheism[2], doubt about your abilities, and lack of self-confidence, which leads to academic failure and endangers the mental and physical health of the individual.

Now a days, techniques of non-invasive brain simulation have replaced drug therapies [5], two technologies of transportation management system and transcranial direct current stimulation have been used to improve cognitive functions in the last two decades. Transcranial direct current stimulation is considered as a neurotherapy that directs a weak, direct current to the cortical region and facilitates or inhibits neural activity in that region. Transcranial direct current stimulation as a form of nerve stimulation is used continuously and transmits a weak direct current connecting two electrodes, anode and cathode and stimulates and inhibits the underlying neurons. Cathode stimulation leads to decreased brain stimulation and anode stimulation is associated with increased brain stimulation.

Transcranial direct current stimulation does not create the action potential[3] in neurons, but

rather provides suitable context for changing the stimulation of neurons by changing the resting potential[4] of neuronal membranes by 1 to 2 mV [6]. According to the results of experiments on healthy adults, transcranial direct current stimulation can improve cognitive function on a variety of tasks related to the area of the brain being stimulated [7].

Cognitive behavioral therapy[5] is considered as one of the treatment methods to reduce students' test anxiety. This treatment is designed to address spontaneous negative thoughts and assumptions and beliefs in emotional disorders. According to this method, individuals are taught how to review and evaluate their negative thoughts. The therapist encourages clients to evaluate their negative thoughts and hypotheses in a real and objective way through behavioral assignments. According to cognitive behavioral therapy, maladaptive thoughts are the cause of maladaptive behavior and people must learn new ways of thinking. Therapists are able to help people rebuild their thought patterns to better cope with stress [8].

A significant number of children and adolescents are recruited each year by schools and over a period of time are required to nurture the scientific and practical capabilities of these individuals and finally provide the community them as trained individuals. The course is a stressful one due to the presence of many factors. Given that students are exposed to new teaching methods and unpredictable demands and given that they do not have the necessary information and preparation for this encounter, probably, their controlling power has been weakened and can't adapt themselves to the environment [3].

Therefore, given that students are exposed to new teaching methods and unpredictable demands at this stage, and given that they lack the necessary information and preparation for this encounter, their controlling power has been weakened and can't adapt themselves to the environment, and sometimes this situation causes students to experience test anxiety. Exam anxiety is considered as a field that has been widely studied since the early twentieth century and has always attracted much attention of researchers as one of the serious issues in the field of education of children, adolescents and even adults [9].

On the other hand, test anxiety and its dimensions as one of the broadest fields of research has attracted much attention of many researchers in recent years. Anxiety disorders is considered as one of the most common emotional and psychological disorders in children and adolescents and test anxiety is one of the serious problems of today's society [10]. It has been reported that the prevalence of test anxiety among students is between 10 and 30% [3]. Therefore, test anxiety threatens students' mental health and has negative and significant effect on their efficiency, talent development, personality and social identity formation, and as one of the pervasive and problematic phenomena affects their academic achievement and optimal performance, especially when evaluating negatively.

New therapies with very high performance and low side effects have been discovered in the field of mental disorders due to the expansion of human knowledge about the brain. Transcranial Direct Current Stimulation is one of these modern therapies. A neuron at rest is negatively charged. When a stimulus reaches a resting neuron, the negative charge moves toward the positive. Intracellular positivity must cross the threshold to lead to create an electrical shock or action potential.

This helps the nerve cell move from a resting state condition to a positive electric charge, which in turn increases the possibility of action potential created by the cell. According to the results of many studies, Transcranial Direct Current Stimulation is more suitable than medication and placebo for the treatment of mild depression, and is also widely used in the treatment of other disorders such as drug and smoking and overeating and anorexia nervosa. [11]. However, students' test anxiety has not been treated using this method.

On the other hand, researchers have always emphasized in choosing therapies with lower cost, more effectiveness, less time and with richer research support, which can be referred to cognitive-behavioral therapy and especially cognitive-behavioral therapy, because this treatment has research support and background, it is rich and can provide group medical and psychological services to a large number of people, especially students. Thus, it seems that it can be very useful to compare these two therapies in identifying more effective treatments. As mentioned earlier in relation to the widespread effects of test anxiety and the fact that self-confidence in students can reduce test anxiety and reduce the negative effects of test anxiety on academic performance, this study can be very important in order to provide an effective and accessible intervention, and according to the possible results of the present study, it can be used in medical and educational models to reduce students' anxiety and finally is affective on their academic quality and academic performance.

According to the results of studies carried out by Ahmadizadeh and Rezaei (2020) [11]; Waqif et al. (2019) [6]; Saeedmanesh et al. (2019) [7]; Hamidi, Sarvaghd, Rezaei and Baqoli (2019) [12]; Mohammadifar, Yasmani and Najafi (2018) [13]; Farsinejad, Karami and Asadzadeh (2018) [14]; Sud (2020) [15]; Kaur.& Kumaran (2016) [16]; Davis (2013) [17], Transcranial Direct Current Stimulation and cognitive-behavioral therapy are effective on test anxiety. In this regard, the present study seeks to examine the following question:

Is there a significant difference between the effectiveness of Transcranial Direct Current Stimulation and cognitive-behavioral therapy on students' test anxiety?

Research Proposal

This study (with ethics code: IR.IAU.BABOL.REC.1399.028 and IRCT code: IRCT20190817044550N3) is considered as a quasi-experimental study with pretest-posttest control group design, which is shown below in Table 1.

Statistical Population, Sample Size and Sampling Method

In the present study, the statistical population includes all male and female high school students in Baladeh region in the academic year 2019-2020 (N=200). First, all male and female high school students in Baladeh responded to the FRIEDMAN Test Anxiety Scale (FTAS) online. The number of people who scored less than 40 was determined to determine the main samples, which were 73 people. Then, 45 of them were selected using random sampling method and divided in three groups of 15, which are described in Table 2. Then, one group was randomly selected as the control group and two groups as experimental groups (Transcranial Direct Current Stimulation and Cognitive behavioral therapy). One experimental group received Transcranial Direct Current Stimulation in 10 sessions of 20 minutes and the other group received cognitive-behavioral therapy in 8 sessions of 60 minutes, but the control group received no intervention. At the end of the intervention, subjects in three groups participated in the post-test.

Table 1: Quasi-experimental study with pretest-posttest control group design.

Test	Intervention	Test	How to appoint	Groups
Post-Test (T2)	Transcranial Direct Current Stimulation	Pre-Test (T1)	Random (R)	Experimental group 1
Post-Test (T2)	Cognitive-behavioral therapy (X)	Pre-Test (T1)	Random (R)	Experimental group 2
Afetr Test (T2)	-	Pre-Test (T1)	Random (R)	Control group

Table 2: Distribution of the main sample by education level and gender.

Groups	The first level		The second level		Total
	Male	Female	Male	Female	
Transcranial Direct Current Stimulation	4	3	5	3	14
Cognitive behavioral therapy	4	4	4	3	15
Control	5	3	4	3	15
Total	13	10	13	9	45

Research Tools

Exam anxiety questionnaire

The test anxiety questionnaire (23 questions) was designed by Friedman IA & Bendas-Jacob O (1997) [18]. The FRIEDMAN Test Anxiety Scale (the FTA) is a 23-item scale consisting of the following three subscales: (a) Social Derogation, (b) Cognitive Obstruction, and (c) Tenseness. The items in this questionnaire are scored on a 4 point Likert scale from 0 (strongly disagree) to 3 (strongly agree). Questions 1 to 8 are related to Social Derogation, questions 9 to 17 are related to Cognitive Obstruction, and questions 18 to 23 are related to Tenseness. In this questionnaire, high scores indicate low test anxiety and low scores indicate high test anxiety.

In a study conducted by Friedman IA & Bendas-Jacob O (1997) [18], Cronbach's alpha coefficient in a sample of 3700 people for each of the above subscales was 0.86, 0.85 and 0.81, respectively, and for the whole scale was 0.91. The reliability of this scale in this study using Cronbach's alpha method for the subscales of Social Derogation, Cognitive Obstruction and Tenseness is 0.89, 0.77 and 0.84, respectively, and for the whole questionnaire is 0.90. According to the results of Friedman and Bandas Jacob (1997) the validity of the questionnaire by calculating the correlation coefficient of this test with the Test Anxiety Inventory (TAI; Spielberger) was 0.84 for boys and 0.82 for girls.

Factor analysis test[6] and structural validity were used in the study conducted by Sadat Sadeghi, Izadifard and Rubenzadeh (2012) [19] to evaluate the validity of this test. All 23 items were analyzed in factor analysis and none of the species had a correlation of less than 0.30. As a result, the test has acceptable validity and its face validity has been approved by the relevant professors and experts. Also, the reliability of the questionnaire with its reliability was calculated using Cronbach's alpha measurement method. It has reported that Cronbach's alpha coefficient of Social Derogation component was equal to 0.90, Cognitive Obstruction was equal to 0.85, Tenseness was equal to 0.83 and total was equal to 0.91 [2].

Research method and data information tool

After a permit from Baladeh Education Department was obtained, the number of male and female high school students in Baladeh in the academic year 2019-2020 was determined and an exam anxiety questionnaire was sent to all female and male first and second high school students online through WhatsApp. Then, the number of students who earned the score below 40 was determined (73 people)

and 45 people were randomly selected and replaced in three groups of 15 people. One group was randomly selected as the control group and the other two groups as experimental groups (Transcranial Direct Current Stimulation and cognitive-behavioral therapy).

The purpose, nature of the research, as well as the advantages and disadvantages of Transcranial Direct Current Stimulation and cognitive-behavioral therapy were explained to subjects and their parents, and informed consent to participate in the study was obtained from individuals; The subjects were assured that the information was kept confidential and confidential by the researcher and the researchers in this study accepted any responsibility for possible accidents. Transcranial Direct Current Stimulation was performed on the first experimental group and cognitive-behavioral therapy was performed on the second experimental group and at the end post-test was performed on subjects in the three groups after the intervention. Beyzaei's Cognitive behavioral Therapy (CBT) (2012) was used in 8 sessions of 60 minutes in this study, which is described in Table 3.

Also, the experimental group received Transcranial Direct Current Stimulation for 10 consecutive sessions (with an interval of 48 hours), each session with a current of 2 mA, anode electrode with a small pad (16 cm) in the area (F3) and cathode electrode with a pad Large (24 cm) in the area (Fp2) for 20 minutes. The electrodes were placed according to the International System 10-20.

Results

Mean and standard deviation of test anxiety in the first experimental group (Transcranial Direct Current Stimulation) in the pretest was 31.13+6.28 and the posttest 39.99±5.99, respectively; in the second experimental group (cognitive-behavioral therapy) in pre-test-post-test was equal to 32.73+5.67 and 45.53+6.80, respectively, and in the control group 32.07+5.75 and 32.20+5.80, respectively, which is shown in Table 4. According to the results, the subjects' scores in terms of test anxiety decreased significantly after the intervention. It should be noted that higher scores in the Exam Anxiety Questionnaire indicate lower anxiety and lower scores indicate higher test anxiety. Thus, increasing the scores from pre-test to post-test in the treatment groups indicates reducing the level of test anxiety after the experimental intervention.

According to the results of the Shapiro-Wilk test[7], the statistical values obtained in the pre-test and post-test of the experimental groups and the control group are more than the critical value ($\alpha=0.05$), therefore the null hypothesis (often denoted H0,) of a

Table 3: Summary of group cognitive-behavioral group therapy sessions.

Sessions	Objective	Solutions and assignments
Session 1	Welcome and introduction, overview of the sessions structure: Training : Introduction of the underlying logic of Cognitive Behavioural Group Therapy program; Discussion about the relationship between thoughts, feelings, and behaviors and ABC model training in relation with exam anxiety	Providing an assignment based on writing the expectations and goals of the training until the next session
Sessions 2,3	Identifying automatic test anxiety-related thoughts, Cognitive-behavioral model training for psychological disorders; Training and trying to make relationship between thoughts, emotions and behaviors; Teaching the role of using alternative thoughts in changing behaviors and emotions	Reminders of several events related to recent test anxiety and their replacement by ABC model; Homework
Session 4	Homework Assessment (related to previous session); Attempting to identify fundamental thoughts and beliefs using the downward arrow technique; Introduction and recognition of logical errors and its relationship with test anxiety; Relaxation training	Practice inidentification and classification of logical errors; Applying the technique of alternative thoughts and challenging with automatic thoughts; Homework
Session 5	Homework Assessment : Discussion about Logical Thoughts and Mistakes; Cognitive Triangle Training in Exam Anxiety; Training the evidence of affirmative and negative evidence to deal with automatic thoughts and logical errors and fundamental beliefs; Relaxation training	Using the technique of affirmative and negative evidence to counter automatic thoughts and logical errors and fundamental beliefs; Homework
Session 6	Homework assessment; Analysis of recorded thoughts and how to challenge them; Discussion about identified assumptions and core beliefs; Training : Challenging basic assumptions and beliefs using evidence-seeking practice and empty seats; Training : problem solving skills	Challenge with basic thoughts and beliefs using the empty seat technique; Problem solving training and applying it to everyday problems; Homework
Session 7	Homework assessment; Discussion about the use of problem solving techniques Training : Practice mental imagery in order to challenge imaginary with basic assumptions and beliefs	Applying mental imagery practice ; Using problem-solving techniques for everyday problems and registering a special sheet,
Session 8	Homework assessment; Overview of practice and skills learned; Comparison of coping thoughts and strategies before treatment with thoughts and strategies and skills learned in treatment sessions to integrate treatment	-

Table 4: Descriptive indicators of test anxiety scores of subjects in three groups in pre-test - post-test.

Groups	Transcranial Direct Current Stimulation		Cognitive Behavioral Therapy		Control	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Pre-test	31.13	6.28	32.73	5.67	32.07	5.75
Post-test	39.47	5.99	45.53	6.80	32.20	5.80

Table 5: Adjusted means of the groups in the post-test after removing the effect of the auxiliary random variable.

Transcranial Direct Current Stimulation		Cognitive Behavioral Therapy		Control	
Initial average	Adjusted average	Initial average	Adjusted average	Initial average	Adjusted average
39.47	40.32	45.53	44.77	32.20	32.11

Table 6: Results of one-factor analysis of covariance to determine the difference in the effect of treatment on the dependent variable.

Square Eta share	The significance level	Ratio f	Average squares	Degrees of freedom	Total squares	Sources Change	Variables
0.923	0.001	245.47	618	2	1236.14	Group	Exam anxiety
			2.52	41	103.24	Error	
			-	44	2949.80	Total	

Table 7: Pair wise comparisons of test anxiety scores by type of treatment.

Comparisons	Exam anxiety	
	Mean difference (MD)	The significance level
Transcranial Direct Current Stimulation Cognitive - behavioral therapy	-4.45	0.001
Transcranial Direct Current Stimulation -control	8.21	0.001
Cognitive - behavioral therapy-control	12/66	0/001

normal distribution is confirmed and the hypothesis 1, there is no normal distribution, is rejected. Also, given that the values of skewness and kurtosis are between -2 to 2, it can be concluded that the data distribution is normal. Also, according to the findings of Levene's Test, the significant level of test anxiety $p= 0.687$ is greater than the alpha level of 0.05 and therefore the same assumption of variance error has been met for test anxiety.

The adjusted means after eliminating the pre-test effect are shown in Table 5. As shown in this table, the mean of test anxiety in the first experimental group (Transcranial Direct Current Stimulation)

from 39.47 to 40.32; in the second experimental group (cognitive-behavioral therapy) has changed from 45.53 to 44.77. It should be noted that higher scores in the Exam Anxiety Questionnaire indicate lower test anxiety and lower scores indicate higher test anxiety.

According to Table 6, the f-ratio from Analysis of Covariance (ANCOVA) indicates that after eliminating the effects of the auxiliary random variable (pre-test), there is a statistically significant difference between the adjusted scores in the post-test of test anxiety scores ($P<0.01$;=F (2 and 41) of the experimental and control groups, indicating there is a significant difference between the effectiveness

of Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy on students' test anxiety.

In other words, Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy have reduced students' test anxiety in different ways. According to the Eta-squared ($\eta2$)[8] or effect size, 92% of the changes in post-test test anxiety are related to the group agent.

According to Table 7, the results of The Bonferroni test[9] show that there is a statistically significant difference between the effectiveness of Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy on students' test anxiety ($P<0.01$; MD=-4.45). According to the results of the table of adjusted means, it can be concluded that the effect of cognitive-behavioral therapy on test anxiety was greater than Transcranial Direct Current Stimulation therapy.

Discussion and Conclusion

This study was carried out aimed to compare the effectiveness of Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy on students' test anxiety. According to the results, a significant difference was observed between the effectiveness of Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy on test anxiety. In other words, Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy has reduced students' test anxiety in a different way and the effect of cognitive-behavioral therapy on anxiety has been greater than Transcranial Direct Current Stimulation therapy. This result is consistent with the results reported by Ahmadizadeh and Rezaei (2020) [11]; Waqif et al. (2019) [6]; Hamidi et al. (2019) [12]; Mohammadifar et al. (2018) [13]; Farsinejad et al. (2018) [14]; Sud (2020) [15]; Wang et al. (2019) [20]; Menella, Patron and Palumba (2017) [21]; Prasko, Hruby, Holubova, Latalove, Vyskocilova & et al (2016) [22]; Kar and Kumaran (2016) [16] and Berryhill & Jones (2012) [23].

Making some changes in cortex simulation isthe basic principle of Transcranial Direct Current Stimulation therapy. According to the results of studies anodal stimulation leads to increased stimulation and cathodal leads to decreased stimulation in the brain. Increased or decreased stimulation of the left or right side of forehead can upset the activity balance in the two hemispheres.

Stimulation of the left dorsolateral prefrontal cortex (DLPFC or DL-PFC) and right dorsolateral prefrontal cortex (DLPFC or DL-PFC) can reduce test anxiety. Anodic stimulation increases neuronal firing, and cathodic stimulation leads to inverse results. Thus, based on this evidence, it is assumed that either an increase in the activity of the right dorsolateral or left dorsolateral leads to decrease test anxiety [11].

According to the cognitive-behavioral approach, making changes in dysfunctional thoughts is the most direct way to change erratic emotions and behaviors. Thus, in this approach, participants become aware of the effect that cognition has on their feelings and behaviors. They learn to identify negative spontaneous thoughts and logical errors in different situations, to achieve the main negative schemas that cause unhealthy behaviors and annoying emotions using the vertical arrow method, and to reconstruct their schemas by empirically examining them, analyzing negative beliefs, Making a note of their opposing beliefs, and interpreting them differently,

as a result, making changes in dysfunctional schemas and cognitive reconstruction to reduce unhealthy and maladaptive behaviors and leads to improve negative emotions and more adjustment of people under training and therefore can reduce the students'test anxiety under training [12].

Cognitive-behavioral group therapy is superior to another therapy, so that it can be said that group therapy in general provides an opportunity for a person to talk about his/her problems and express his feelings in the group and receive feedback; and achieves success in determining the attitude and attitude of others towards themselves. Thus, students can have less self-criticism, learn cognitive-behavioral therapy skills better in the group process, and use them better and students can benefit from group interaction to increase understanding and acceptance of values and goals and learn to change or get rid of certain behaviors and attitudes, and thus these processes have been able to help reduce test anxiety in cognitive-behavioral therapy significantly [13].

Furthermore, different personality traits which disrupt positive activities (perfectionism, fear of failure, low self-esteem), is another factor in the superiority of cognitive-behavioral therapy in reducing anxiety, so that it is effective on decreasing the anxiety, because it seems that the existence of perfectionism, fear of failure and low self-esteem can cause a person to procrastinate and prevent his/her from being fully prepared for the exam, and this in itself can increase the exam anxiety. On the other hand, it seems that the existence of perfectionism, fear of failure, low self-esteem, will also increase the test anxiety.

Thus, given that this study has tried to reduce the severity of perfectionism, fear of failure, low self-esteem using existing techniques, it can be expected that at the end of the sessions, students undergoing cognitive-behavioral therapy training show a significant reduction in test anxiety. Therefore, given that cognitive-behavioral therapy emphasizes personality components in the treatment of test anxiety in cognitive-behavioral therapy, this treatment has been able to make cognitive-behavioral therapy superior to the Transcranial Direct Current Stimulation therapy [14].

Also, reconstruction of the students' thoughts and beliefs enables them to identify their misconceptions about the exam and gradually replace it with the right beliefs, and this allows them to assess their problem from different dimensions. As a result, new opportunities will be provided for them and their attitude towards the exam will change and they will choose their goals realistically and take responsibility for their actions and thoughts, and their emotional and behavioral responses will also change. Making changes in beliefs and thoughts not only about the exam, but also about academic performance enables them to change their expectations, to have reasonable expectations of themselves, to act in a better and more effective way, and as a result to experience less exam anxiety. The use of relaxation as a treatment and process diverts students' awareness of anxious emotions and reduces anxiety and the physiological aspects of anxiety [13].

It was not possible to conduct the questionnaire in person due to the Covid-19 virus pandemic and following the essential health protocols that could have achieved better results. The present study did not investigate the role of factors such as socioeconomic class, education level of parents, cultural status, etc. in comparing the effectiveness of Transcranial Direct Current Stimulation therapy

and electrical cognitive-behavioral therapy. The effectiveness of Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy on students' test anxiety in the follow-up phase wasn't studied due to time constraints and it made impossible confirmation and proof of the durability and stability of cognitive-behavioral therapy and Transcranial Direct Current Stimulation therapy. Also, it is recommended to follow up the effectiveness of Transcranial Direct Current Stimulation therapy and cognitive-behavioral therapy on test anxiety in post-treatment periods by considering the effectiveness of cognitive-behavioral therapy on students' test anxiety, it is recommended that school counselors take effective steps to reduce test anxiety by using group cognitive-behavioral therapy. It is recommended that therapists in the field of anxiety, especially test anxiety, use cognitive-behavioral therapy in order to make cognitive-behavioral therapy effective on students' test anxiety and also the cost-effectiveness of this treatment. Also, it is also recommended that the relevant authorities prepare a brochure and booklet on cognitive-behavioral therapy and distribute it among school counselors and teachers so that they can take practical steps by using the content of this training to reduce students' test anxiety and the principles of cognitive-behavioral therapy should be provided to students in the form of a brochure. Due to the positive and significant effect of Transcranial Direct Current Stimulation therapy on students' test anxiety, it is recommended to use this treatment along with other psychological therapies to reduce test anxiety in a more effective way.

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[1]Self-deprecation is the act of reprimanding oneself by belittling, undervaluing, or disparaging oneself, or being excessively modest.

[2]Atheism is in the broadest sense an absence of belief in the existence of deities.

[3]An action potential is defined as a sudden, fast, transitory, and propagating change of the resting membrane potential.

[4]The relatively static membrane potential of quiescent cells is called the resting membrane potential (or resting voltage), as opposed to the specific dynamic electrochemical phenomena called action potential and graded membrane potential.

[5]Cognitive behavioral therapy (CBT) is a short-term, goal-oriented psychotherapy treatment that takes a hands-on, practical approach to problem-solving.

[6]Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors.

[7]The Shapiro–Wilk test is a test of normality in frequentist statistics. It was published in 1965 by Samuel Sanford Shapiro and Martin Wilk.

[8]Eta-squared is commonly used in ANOVA and t test designs as an index of the proportion of variance attributed to one or more effects.

[9]The Bonferroni test is a statistical test used to reduce the instance of a false positive. In particular, Bonferroni designed an adjustment to prevent data from incorrectly appearing to be statistically significant.