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The Effectiveness of the Training based on Executive Functions on Student's Mental Vitality

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ABSTRACT

Objective: This research was conducted with the primary objective of examining the efficacy of a training program focused on enhancing executive function skills on the Mental Vitality of students.

Methods: To achieve this aim, a quasi-experimental research design was employed, implementing a pretest-posttest approach with the inclusion of a control group. The target population for this study consisted of all male fifth-grade students in Shahreza, Iran, during the academic year 2020-2021. Utilizing the available sampling method, a total of 40 students, including a primary school boy, were randomly chosen to participate in the study. These participants were then divided into two groups of equal size, each comprising 20 individuals, with one group designated as the experimental group and the other as the control group. The experimental group underwent a series of 10 training sessions focused on improving executive functions, while the control group did not partake in any intervention activities. Data collection procedures involved administering Ryan and Frederick's (1997) Mental Vitality scale to all participants in both groups during the pre-test and post-test phases. Subsequently, the collected data underwent analysis utilizing the ANCOVA statistical method.

Results: Analysis of the results revealed a significant enhancement in Mental Vitality among students in the experimental group following the executive function-based training compared to those in the control group during the post-test assessment ($P<0.05$).

Conclusions: These findings suggest that integrating training programs centered on executive functions can effectively enhance students' Mental Vitality within school and educational settings.

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Introduction

Research focusing on the significance of executive function skills in shaping educational advancement, behavioral adjustment, effective learning, and peak academic performance among students has garnered considerable attention from numerous scholars in the field (Dias et al., 2022); that in the present circumstances, it can be observed that education holds a significant position in the lives of students and has exerted a crucial influence on their future across various aspects (Greiner et al., 2022). Given that the rate of advancement and decline in education serves as a key metric for assessing the effectiveness of the educational system (Salsbili & Ghasemi, 2005); The exploration and analysis of factors impacting academic achievement have contributed to an enhanced comprehension and anticipation of factors influencing academic advancement within educational institutions (Sepahvandi et al., 2016). One of these variables is mental vitality. Mental vitality is defined as having physical and mental energy, and people with mental vitality have experienced a sense of enthusiasm and energy (Jo, 2017). People with high mental vitality can also be more productive (Martin-Cuellar et al., 2021). Individuals exhibiting elevated mental vigor have described their state as one devoid of discord with external surroundings, characterized by autonomy, and marked by the capacity to engage with and impact the immediate milieu. They perceive themselves as the primary agents of their behaviors, directing their energy towards intentional endeavors that are carefully managed (Velachopoulos, 2009).

Mental vitality leads to a positive attitude to life, a positive self-concept, good writing, and effective work and academic performance (Mack et al., 2011). Mack et al. (2011) in the research showed that fulfilling the need for competence and independence can predict mental vitality and mental health. People who had higher mental vitality had more self-efficacy beliefs (Ghanbari-Talab & Shaykh al-Islami, 2014). Vitality or the availability of energy for oneself is an important and fundamental indicator of health and motivation (Ryan & Deci, 2001). Vitality increases creativity and individual activity facilitates social relations and is an important factor in maintaining health and increasing people's lifespan (Mazzucci et al., 2008). Although vitality is derived from an internal source (Bostick et al., 2003), subjective vitality originates from intrinsically motivated behaviors (Ryan & Deci, 2001). But mental vitality is different from the concept of intrinsic motivation because intrinsic motivation is operationalized in the context and is a set of reasons that people show behavior for those reasons, while is that mental vitality is

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within the scope of classification of motivational consequences with an emotional nature (Velachopoulos, 2012). According to the self-determination theory, the feeling of cheerfulness originates from an inner place, and the concept of cheerfulness is perceived as an energy that comes from oneself; Therefore, happiness can be conceptualized by the experience of self-determination (Deci & Ryan, 2000; Ryan et al., 2008). Although within the scope of self-determination theory, both the mutual influence of external forces affecting the individual and the internal and inherent needs and motivations of humans are included (Sanley et al., 2013); most of the research related to self-determination theory is focused on how social factors affect the quality of performance and mental health of people. According to Ryan et al. (2008), modifying the environment to provide a sense of independence in people and support self-following, will most likely lead to an increase in mental health and mental vitality. Experimental findings showed that self-determined and self-directed behaviors lead to an increase in mental vitality. On the other hand, controllability will harm happiness even when a person is controlled to achieve his personal goal (Rese et al., 2000). Controlled actions, in such a way that a person is forced to think, feel or behave in certain ways, are like an obstacle that stands in the way of a person's energy (Desi & Ryan, 1985). This obstacle reduces a person's energy. Ryan and Frederick (1997) showed that when the actions are motivated autonomously, the mental vitality of the person is higher than when the actions of the person are controlled; Because a person has his energy and manages it. According to the study of Hope et al., (2016), people also experience happiness when pursuing a goal; In this way, pursuing goals that are connected to inner ideals will lead to feeling more cheerful. According to the cognitive point of view, mental processes are improved through educational interventions and based on this understanding, planning can be done to improve these processes in students. Since the end of the 18th century, various programs have been developed to develop cognitive abilities, and the most promising of these programs are educational interventions based on executive functions for students so most studies show the usefulness of this program (Gailo, 2017; Blanki & Nokes-Malach, 2009; Zimmer et al., 2021; Chen et al., 2020). Executive functions are a set of cognitive processes that have been introduced in the form of planning, organizing, working memory, response inhibition, time management, task initiation, and goal-based resistance (Dawson & Gwire, 2004). Executive functions depend on factors such as self-efficacy, personal control in success and failure, the value of the task, and the effort of students and the class (Lenin-Brink &

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Pintrich, 2003). These functions are essential in attention control, inhibition control, working memory as well as reasoning, problem-solving, and planning (Diamond, 2013). In addition, this educational intervention creates opportunities for students that make them aware of their strengths and weaknesses and improve their attention, processing speed, and learning. Executive function dysfunction is associated with impulsivity, emotional dysregulation, uncontrollability, lack of attention, planning, and problem-solving (Chen et al., 2020). Keshavarzian and Zarei Guniani (2020) showed that executive function training affected neuropsychological abilities and attention control in children with learning disabilities. Sadeghi (2018)showed that training in executive functions affects improving the planning and working memory of students with mathematical disabilities. Azizian et al (2017), after designing the training package of executive functions, confirmed its effectiveness on the academic progress of late-learning students. Research has shown that training and development of executive functions have played a key role in expanding social and emotional capabilities (Marquio et al., 2018), academic and school abilities (Debrigen et al., 2018).

In previous studies, no evidence of research conducted either domestically or internationally was discovered, with the exploration focusing primarily on executive functions within the academic realm, particularly within the context of Iran, predominantly centering on topics such as learning disabilities, hyperactivity, and lack of attention. This particular subject matter has been thoroughly examined and discussed, shedding light on the potential benefits of such studies in enhancing the psychological well-being of students. Therefore, it is imperative to allocate additional resources and efforts towards delving deeper into this area through the undertaking of a multitude of research endeavors, as this could prove to be a pivotal measure in bolstering the cognitive acuity and mental robustness of students. With this in mind, the central query that arises from the existing body of research pertains to the impact that an educational curriculum grounded in executive functions may have on the mental vitality of students.

Material and Methods

Design

The present study is a quasi-experimental study conducted by pretest-posttest design via a control group.

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Participants

The statistical population of the current investigation comprises all male fifth-grade students in Shahreza province during the academic year 2020-2021. Within this research, elementary school male students were chosen at random, and based on the predetermined criteria for inclusion, a total of 40 students were designated as the research sample utilizing the accessible sampling technique, with random allocation into experimental and control groups.

Instrument

Mental vitality was designed and validated by Ryan and Frederick (1997), this scale measured energy and enthusiasm for life as a trait. This scale has 7 questions (Likert scale 1-7) and the completely agree option was assigned a score of 7 and the completely disagree was assigned a score of 1. The minimum score obtained is 7 and the maximum score is 49; higher scores indicate greater mental vitality. This questionnaire has been validated by Sadidi (2012). In the country of Iran, in 2002, Mrs. Abolqasmi reported Cronbach's alpha coefficient of 0.85 (quoted by Sedidi, 2012). In Sadidi's study (2012), the opinions of the supervisor and several other professors and experts were used to obtain the validity of the questionnaire. Cronbach's alpha-validity of the mental vitality scale is 0.94 and its structural validity has been confirmed by factor analysis (Milyavaskaya & Kostner, 2011). In the research of Sheikh-ul-Islami and Daftarchi (2014), Cronbach's alpha coefficient was used to check the validity of this scale, and its alpha coefficient was 0.89. Also, to check its validity, the correlation of each item with the total score of the mental vitality scale was calculated. The coefficients range was obtained from 0.57 to 0.86, and all coefficients were significant at the 0.001 level (Sheikh al-Islami & Dofterchi, 2014).

Procedure

After selecting the participants, the experimental group was trained for (10 sessions of 70 minutes) package for executive functions using the instructional design model (Azizian et al, 2017) and the control group remained on the waiting list. It should be noted that this training package is based on various theories, sources, and research in the field of executive functions. Inclusion criteria included: attention to the same age group, fifth-grade male students, and parental consent. Exclusion criteria had more than 2 sessions of absence and did not carry out more than 2 research-related tasks. In addition to content validity, this package was reviewed in terms of structural

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validity by competent experts, and its reliability coefficient was calculated by the evaluators to be 0.89. The reason for using this training package in terms of application compared to pre-determined intervention programs was their ability to modify quality, the ability to include a variety of software games and paper pencils, its accompanying guide, attractiveness, objectivity, and reproducibility (Azizian, 2017). In the end, individuals in both groups responded to the post-test. The stages experienced by the experimental group is demonstrated in table 1. Also, the ethical considerations of this research were the confidentiality of the collected information, the consent of the parents of the students to participate in the research, and the necessary freedom to participate with the researchers.

Table 1. Summary of executive functions training sessions

Sessions	Topics
Sessions 1 and 2	Introduction, purpose, motivation, and completion of the pre-test. Attention and concentration training
Sessions 3 and 4	Mental Vitality training
Sessions 5 and 6	Inhibition training
Sessions 7 and 8	Organizing training
Sessions 9 and 10	Training, in planning, summarizing and completing the post-test

In each session, the exercises of the previous session were reviewed for 10 minutes before the start of the training. 30 minutes of the session were dedicated to electronic games and 30 minutes to hand games. Each session was attended by two students, one playing electronic games and the other engaged in paper-pencil training games, and the researcher simultaneously directly and indirectly guided and supervised their activities. Descriptive and inferential statistics were also used to extract and express the results. After gathering the data, data analyses and evaluation of descriptive mean and standard deviation and inferential statistics analysis covariance were performed using SPSS-22 software.

Results

According to Table 2, the mean age of students in the control group was 11.80 with a standard deviation of 0.9 and the mean age of the experimental group was 11.40 with a standard deviation of 0.8.

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Table 2. Comparison of age of students in control and experimental group

Group	Mean	SD	N
Control	11.8	0.9	20
Experimental	11.4	0.8	20

Table 3 shows the mean and standard deviation of pre-test and post-test scores of Mental Vitality in both control and experimental groups. The data show that Mental Vitality has increased in the post-test of the experimental group, and we use covariance analysis for its significance test.

Table 3. Mean and standard deviation of Mental Vitality in pre-test and post-test

Variable	Group	Pre-test		Post-test	
		Mean	S.D	Mean	S.D
Mental Vitality	Control	28.90	7.81	29.00	7.82
	Experimental	30.25	7.07	31.40	6.85

The assumptions underlying the application of parametric tests and analysis of covariance, specifically the tests for normality of variable distribution and homogeneity of variance, are initially conducted prior to examining the research hypothesis. Prior to utilizing parametric statistical tests, an assessment must be made to determine whether the distribution of the variable is normal. In this regard, the Kolmogorov-Smirnov test was employed, as indicated in Table 4. As the significance levels obtained exceed 0.05, it is concluded that the distribution of the research variable is indeed normal. Consequently, parametric tests are applied for data analysis.

Table 4. Test of normality of Mental Vitality variable using Kolmogorov-Smirnov test.

Phase	Z	P
Pre-test	0.534	0.938
Post-test	0.743	0.638

As per the findings presented in Table 5, the Levene's test value and the significance level pertaining to Mental Vitality are reported as 0.238 and 0.828, respectively. These values are derived based on the observation that the significance levels in the aforementioned assessment exceed the threshold of 0.05, and additionally, the assumption of variance homogeneity has been validated. Consequently, it is plausible to consider employing covariance analysis tests in this context.

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Table 5. Levene's test for homogeneity of variable variance

Variable	Levine's statistics	Df_1	Df_2	p-value
Mental Vitality	0.238	1	38	0.828

Now, an examination of the principal hypothesis of the study concerning the impact of an educational program rooted in executive functions on the Mental Vitality of fifth-grade male students in Shahreza city is to be conducted. The hypothesis was evaluated utilizing a one-way (one-factor) univariate analysis of covariance. As illustrated in Table 6 below, it is apparent that the significance levels pertaining to the cohort (educational program based on executive functions) in relation to the overall Mental Vitality score are below 0.05, indicating a 95% level of significance for the aforementioned test. Thus, it is plausible to conclude that the educational package emphasizing executive functions exerts a discernible influence on the Mental Vitality of students. Analysis of the mean values reveals a post-training increase in Mental Vitality subsequent to the implementation of the executive functions-based instructional program. Eta squared values suggest that 12% of the variance in Mental Vitality can be accounted for by the executive functions-oriented training program.

Table 6. Analysis of covariance of post-test Mental Vitality, with training package based on executive functions

Dependent variable	SS	DF	MS	F	p-value	Eta squared
Post-test	1965.082	1	1965.08	828.88	0.000	0.957
Group	11.946	1	11.946	5/039	0.031	0.120
Error	87.718	37	2.371	-	-	-

Discussion

The current investigation aimed to assess the impact of an educational program centered on executive functions on the cognitive well-being of male students enrolled in the fifth grade at a primary school in Shahreza city. Executive functions, in conjunction with motivational beliefs, are intricately linked and can be influenced by various factors, consequently shaping one's perception under specific circumstances. Students exhibiting advanced executive functions utilize cognitive strategies, engage in self-assessment post homework completion, evaluate their work against predetermined objectives, and consistently strive towards the attainment of these goals. The results of the research of Blanki and Nokes (2009) which investigated the type of manipulation and the speed of problem-solving (metacognition and problem-oriented) as part of executive processes on learning, showed that students who have better executive functions have higher performance in

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these variables and have higher academic progress. Also, according to the research findings, the training package based on executive functions affects increasing mental vitality. The aforementioned results with the findings of Ghanbari-Talab and Shaykh al-Islami (2014); Hope et al. (2016); Sunley et al. (2013); Mack et al. (2011); Mazzucci et al. (2008); Ryan et al. (2008) and Deci and Ryan (2000) are consistent. When interpreting the outcomes, it is plausible to assert that enhancing executive functions through a focus on the performance process may result in a reformation of one's personality, consequently leading to sound thinking and performance, thereby primarily benefiting the students themselves.

The training of executive functions encompasses interventions aimed at honing skills such as planning and response inhibition, ultimately fostering advancements in behavioral and cognitive performance among students. This, in turn, enhances their zest, vigor, and cognitive acuity. As per the tenets of self-determination theory, the sense of joy emanates from an intrinsic source, with happiness being construed as an emanation of inner energy; hence, the concept of happiness can be grasped through the lens of self-determination. While self-determination theory encapsulates both the mutual impact of external influences on individuals and the internal innate needs and motivations of humans, the bulk of the research pertaining to this theory delves into how societal factors influence individuals' performance quality and mental well-being. These studies explore scenarios that foster feelings of autonomy, competence, and relatedness within a given environment. In general, students exhibit a decline in impulsive and aimless conduct when employing executive functions, with a simultaneous boost in enthusiasm and vitality, culminating in enhanced cognitive well-being. It is imperative to acknowledge that irregular attendance at meetings and securing family cooperation, along with effective time management, extended the duration of the research project. Given the study's confinement to a single locale, caution must be exercised when extrapolating the findings to a broader student population. Moreover, participants' familiarity with the questionnaires during the pre-test may serve as an intervening variable during the post-test, potentially influencing the research outcomes. Additionally, several research and practical recommendations are proffered herein. These include exploring the impact of executive function-based training on female students in comparison to the extant findings, probing other factors like self-esteem and psychological resilience post-training, and advocating for an examination into treatment stability and follow-up durations in future inquiries. Undertaking

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analogous studies in diverse urban centers with larger sample sizes could yield more robust outcomes. Lastly, evaluating the efficacy of this educational regimen vis-à-vis other programs in the domain of cognitive well-being is warranted.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by ethics committee of Yasouj University.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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