Review Article

Executive Functions and Educational Achievement with an Approach to Captain's Log Software

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Abstract:

Background:

The aim of this study is to investigate the executive functions and educational achievement with an approach to Captain's Log software.

Method: The present study is applied in terms of purpose and descriptive and revisal in terms of method.

Result: The results showed that the issue of being successful in education is one of the most important concerns for the educational system in all societies. Educational achievement refers to the ability learned or acquired in school subjects, which is measured by standardized learning tests or teacher-made tests and means the amount of individual learning in the school so that they can be studied as factors related to individual differences and related to school and education system.

Conclusion: Studies have shown that delays in executive functions increase the likelihood of adaptation and learning problems, and it is important to pay attention to these functions in order to improve students' performance in academic subjects. Executive functions are a set of cognitive abilities that are responsible for self-regulation and goal-oriented behaviors that enable the individual to create new patterns of behavior and ways of thinking and reviewing thoughts.

Keywords: Executive Functions, Educational Achievement, Captain's Log Software

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Introduction

Students have important capacities that flourishing of them is a necessary and essential condition for the success and development of any society, but the existence of numerous risk factors in this direction has always caused short-term and long-term individual and social harms (1). In other words, students are the intellectual and spiritual assets, and the main element of the country's education system, so the investigation of appropriate methods to promote their educational achievement is one of the most important goals of education in any society (2); because students' failure to learn what is taught to them will lead to stagnation of education and backwardness of society. At the same time, one of the main concerns of humanity throughout the ages has been to enable the next generation to manage their own affairs and to leave a cultural and scientific heritage. Education is considered as a long-term investment in many societies, which is achieved at the expense of ignoring the short-term growth of other community facilities, but given the high individual and social costs paid for educational problems, and since the efficiency of the education system depends on the academic achievement of learners, if the education system does not do its job properly, the process of growth and development will be hindered (2).

Research shows that executive functions are one of the most important and effective factors in students' educational failure. A student who performs weakly in executive functions, hates school or certain aspects of homework at school, and as a result avoids homework, becomes unmotivated, and behaves irresponsibly, and as a result educators and teachers often see a reciprocal decline in his/her behavior. So not only the student uses strategies to avoid failure, but he or she also seeks to attract the positive attention of his or her peers, and this affects his or her life cycle. Therefore, it is necessary to break this invalid cycle by being aware of the executive functions and its components and explaining its impact or relationship with different educational variables by providing interventions based on improving these functions. In other words, students who have strong executive functions have high motivation and good performance, even in the face of stressful events and circumstances that can put them at risk for weak performance and ultimately drop out of school. Therefore, by focusing on executive functions and trying to strengthen it and providing the necessary conditions for training students with strong executive functions, more useful measures can be taken in the development of today's education-oriented society (3).

Research background

(4) during a study examining the effectiveness of Captain Log cognitive software on visual-spatial perception of students with learning disabilities reported that the effect of Captain Log cognitive software on visual-spatial perception of students with learning disabilities 81.1% was 59.8% on verbal visual-spatial perception and 36.7% on non-verbal visual-spatial perception memory. Considering the advantages of Captain Log software on students' visual-spatial perception, it is suggested that this software be taught to teachers of students with learning disabilities.

(5) Reported the effectiveness of computer cognitive rehabilitation on working memory, sustained attention and mathematical performance of children with autism spectrum disorders and this effect has remained stable in the follow-up phase. Therefore, since this program was designed in order to improve working memory, sustained attention, and mathematical performance in children with autism spectrum disorder due to its attractive visual / auditory design and increasing level of difficulty; It is suggested that this technology be used at a lower cost to treat and improve the cognitive functions of people with autism spectrum disorders and similar disorders.

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(6) Investigated the effectiveness of Captain Log cognitive software on working memory of students with learning disabilities. The results of this study showed that Captain Log cognitive software has a positive effect on working memory (verbal and non-verbal) of students with learning disabilities.

(7) Examined the effectiveness of computer-assisted cognitive rehabilitation on improving executive functions of response inhibition in children with attention deficit / hyperactivity disorder and reported that computer-assisted cognitive rehabilitation in improving executive functions of response inhibition in children with attention deficit disorder / Hyperactivity is effective.

(8) Examined the effect of teacher-centered executive function training on improving executive functions and showed that teacher-centered executive function training can lead to a significant improvement in the executive functions of preschool children.

Reported in a review study entitled Cognitive Rehabilitation for People with Multiple Sclerosis that providing intervention in verbal learning and memory could change the cognitive domain of patients with MS.

(9) In a study on group cognitive rehabilitation in multiple sclerosis provided evidence that the effectiveness of cognitive rehabilitation interventions related to brain changes is related to it is an effective cognition that ultimately improves daily performance.

(10) Examined the effect of executive function training on children with attention deficit / hyperactivity disorder. The results of this study showed that executive function training is effective on children with attention deficit / hyperactivity disorder and their parents and has led to a reduction in the symptoms of attention deficit/ hyperactivity disorder and greater adaptation.

(11) Examined the effect of cognitive skills training on homeless youth. The results of this study showed that cognitive skills training leads to a significant improvement in cognitive skills and psychological distress of homeless youth.

Theoretical foundations of research

Executive functions

Cognitive functions are the product of brain processing processes and include two subsets; one is rule Base functions that regulate and control the thinking and performance of the individual and is known as executive functions, and the other is non Rule Base Functions that are based on emotions, desires, social cognition and situational influencing factors .Executive functions include cognitive flexibility and the ability to manage intervening components in goal-oriented behaviors and to anticipate the consequences of a performance (12).

Executive functions are among the abilities that children will need in the future for school learning and regulate behavioral outputs, and usually include inhibition and control of stimuli, working memory, cognitive flexibility, planning, and organization (13). In other words, executive functions are a set of excellent abilities, including self-management, self-initiation, planning, cognitive flexibility, working memory, organization, dynamic perception of time, predicting the future, and problem solving that assist children in daily activities and learning tasks (14).

A group of researchers group these functions into different cognitive domains to explain the executive functions of the concept of how and why human behavior, and another group groups these functions into different cognitive domains, including planning and organizing behavior, inhibiting and controlling response, continuity of performance, and reducing dominance. And the ability to start performance (12).

provides evidence for the division of executive functions into three cognitive components, including containment, transfer, and improvement, which, although separable, all play a role in the process of regulating and controlling many functions. Other components

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that these researchers introduced are planning, decision making and problem solving. Another division of executive functions into core domains includes the five components of immediate response inhibition, planning, cognitive flexibility, attention transfer, and working memory (15).

The ability to suppress irrelevant and disturbing stimuli or impulses is a fundamental executive function that is essential to the process of normal thinking and ultimately to successful living (16). A number of important features of the human mind are termed "executive control" or "executive functions." Executive functions include: the ability to start, control, or stop activity, flexibility in information, logical inference, think abstractly, responding to new information and situations, information sequencing, and correct behavior in a targeted manner; Active Memory Programming, Response Inhibition, Abstract Thinking, and Attention Control; Cognitive flexibility, creating, maintaining and modifying cognitive devices to respond to changes in environmental demands, formulating and testing hypotheses, self-controlling, purposeful behavior, preventing the automatic response of the accustomed response (17).

Theories of executive functions

As a person goes through life, many mental skills and processes help him to plan for the tasks and duties, challenges and opportunities he faces and to be accountable for "executive functions". Researchers and psychologists use the term "system of cognitive controls" to describe executive functions. The set of executive functions, as it affects the disabled, affects everyone, young and old. These functions affect a person's performance at school, workplace, emotional responses, personal relationships, and social skills. However, all executive functions are somewhat different in each of us; each person has unique strengths and competencies in some areas of cognitive control and weaknesses in others. There are various models of executive functions and neural anatomical structures that discuss executive functions extensively. These include the (18) model, Ward's three-tier model, the brain CEO or orchestra leader model (19).

Models of executive functions are:

Brown model

The model proposed by (18) includes six clusters of executive functions and is a way of conceptualizing executive functions for all individuals. None of these clusters are a single variable such as height, weight, or blood pressure. Each cluster is more like a basket that contains related and diverse cognitive functions. These clusters are:

1- Activity: Organizing, prioritizing and activities for work, innovation, planning, policy setting and arranging.

2- Focusing: focus, stability and change of attention in the task.

3- Effort: Adjusting awareness, effort stability and processing speed, speed of action, time management and resistance to distraction.

4- Emotion: Failure management and emotion regulation.

5- Memory: The usefulness of working memory and available reminders, the use of feedback.

6- Action (action): control and self-regulatory action, inhibition.

Each of these clusters seems to be operational functions that are effective in rapidly changing the set of interactive (reciprocal) forces that are performed somewhat unconsciously. These functions regulate a diverse range of daily tasks that individuals must use attention and memory to guide action before they can control themselves 18.

The model of the brain CEO or conductor (McCloskey)

Executive functions are not a single structure or feature; executive functions are referred to

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as the "brain CEO" or "conductor"; this metaphor refers to the nature of executive functions. But this concept was developed after perceptions of the central control center or unique control capabilities (19).

(13) Introduced the truth of executive functions as the "g" in neuropsychology. Goldberg referred to executive functions as "s" under the heading of intelligence. But both have used the orchestra leader's allegory as a metaphor for performance processes. This allegory is based on the "problem of the infinite recursive model of the brain" or on the backward paradoxes of the unlimited or a complex metaphysical maze. To solve everyday problems through objective behaviors, it is better to use the "co-conducting or harmonizing" link system instead of the leader. So it is better to look at the performance functions as a group of orchestral conductors with mental abilities. The range of theoretical definitions implicitly or explicitly considers control processes as part of intelligence. Hypothetical definitions, to a limited extent, often implicitly consider executive functions as part of problem solving or reasoning in intelligence (19).

Because executive function leaders include a large group operating along different growth lines, a hierarchical multidimensional model is needed to depict their reality. In this model, growth goes in the direction of levels and growth at one level requires the acquisition of skills at previous levels. In the case of executive functions, hierarchical growth levels can also be considered as a set of independent growth lines; therefore, in this theory, executive functions are multi-tiered. There are a total of 23 functions that guide perception, emotion, cognition, and action (19).

Educational Achievement

Undoubtedly, in today's advanced world, one of the signs of success is academic achievement, without which the development and progress of any country will not be possible. The progress of any country is directly related to the progress of science, knowledge and technology of that country, and scientific progress is not achieved unless creative people are trained. And as a result, the income is enough. Students with educational opportunities are treated with respect by family and the community. They will be present in the society with more spirit and vitality, and at the same time, the exorbitant costs that will be imposed on education due to the lack of education will be reduced. Achieving productivity and improving the quality of the education system can be considered the most effective factor in the development of countries. The experiences of developed countries such as Japan in the field of comprehensive development also indicate investment in educational and human resources. In order to achieve these goals, improving the quality of educational status is one of the main goals of educational programs. Today, however, academic failure is one of the concerns of families and those involved in education. One of the topics of interest for educational science experts is finding the necessary and effective conditions and facilities for successful education and academic achievement. But failure in education causes individual and social problems and deviation from achieving the goals of the education system. Researchers have identified various factors involved in students' academic achievement. However, due to cultural differences and rapid changes in factors over time, it is not possible to propose specific causes for societies as a general law. Because the laws of cultural context and the relationship of society, people's attitude towards education, parents' income level, etc., are all factors that affect academic failure or success, especially in a society. Available sources show that education is generally influenced by five pervasive factors of educator, program, equipment and educational environment, each of which has characteristics that can have

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different effects on academic achievement and learning (20).

Each person is equipped with some tools to enter the community and as a result to face different situations and different people (culturally, economically), these individual tools can be considered as psychological structures that can help him cope with life events. To help, these psychological structures are mutually influenced by various factors such as family, community, peer group, etc. on the other hand. For this reason, researchers have always paid much attention to the effects of these psychological components on various aspects of people's lives, including the effect of these components on job, academic and social performance. Among these, academic achievement has been considered more by psychologists than other variables. Because it seems that what can help a person, a family, ultimately a country in the path of development, most of all, is the benefit of people who not only have good mental health, but also successfully complete their education in education. Awareness of students' psychological aspects can act as a powerful teaching aid tool. For example, understanding how a student behaves in certain situations can increase the effectiveness of educational tools as well as teacher teaching methods and the education system and ultimately students' academic achievement (20).

Cognitive rehabilitation and training of neuropsychological exercises in Captain Log software

Cognitive rehabilitation is a process of active change that is done to empower people with injury and disease and its goal is to regain the optimal level of lost functions. According to the definition provided, it is a general term and its purpose is to restore and compensate all the physical, mental and social functions damaged by diseases. According to the existing definition, cognition is the ability to pay attention, receive and understand information in order to modify, integrate and maintain them, which is in line with effective interaction with the environment, and consequently cognitive training of the brain or neuropsychological rehabilitation can be defined as:

Cognitive rehabilitation is a set of methods with intervention strategies, which is done to empower clients or patients and their families and aims to adapt, control and reduce cognitive deficits. Due to the nature of cognitive disorders, the goals of cognitive rehabilitation in the first category of function through adaptation to disease (adaptation to disability and disease) and the second purpose is to prevent and reduce maladaptive behaviors and eventually compensate for some lost defects. In a general summary, the National Institutes of Health believes that the goal of brain cognitive training is to increase an individual's ability to process and interpret information and to improve his or her performance in all aspects of social and family life (21).

The process of forming cognitive rehabilitation

The spread of knowledge about the mechanism of the brain by increasing the production and use of brain imaging tools and its more detailed study at the same time with the cognitive revolution in the 1970s has led to the emergence of interdisciplinary sciences such as cognitive neuropsychology, behavioral neuropsychology and so on. These new approaches, in addition to recognizing and studying brain functions, were very effective in shaping new therapies, because since then, the use of interventions based on neuropsychological rules has begun and terms such as cognitive rehabilitation and neuropsychological rehabilitation have been introduced in scientific texts. Functional brain diseases such as schizophrenia, acquired brain diseases such as stroke and stroke, and progressive and destructive diseases such as dementia. Preliminary research on cognitive

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training in the brain was mainly performed on patients with schizophrenia. For cognitive rehabilitation of these patients, the information processing approach was usually used and its effects on the individual's communication, attention to environmental issues and how he reacts were studied (Alibigi, Mohammadkhani, Mazinani and Dolatshahi, 1390).

Mechanisms of effect of cognitive training of the brain

After years of research, the question of how and in what way neuropsychological rehabilitation improves cognitive functions remains unanswered (21). In response to this question, Kandel and Kolb, two of the most famous contemporary neuropsychologists, hypothesized that "the action and interaction of neurons underlies behavior." If this basic assumption is accepted, it must also be accepted that whenever behavior is pathologically defective (such as aphasia), it is due to a defect in the functioning and interaction of the nervous system, which is the main cause of the behavior (language). Therefore, this logic should be used in the next step that when there is an improvement in function, this improvement will be related to cellular / neurological, neurochemical and neuropsychological underlying events (22).

Cognitive rehabilitation approaches

Although relatively little information has been obtained about the healing mechanisms and how the interventions work and the field of brain cognitive education lacks comprehensive models of brain cognitive education, but several approaches have been adopted and each has different goals and hypotheses and different methods (23).

Repair damaged function

In general, full repair of damaged function and bringing it to the default level, although very valuable, is in most cases far from reality. This approach is the percentage of improvement of underlying defects and consequently the overall improvement of cognitive functions. The methods used based on this approach mainly emphasize stimulation or cognitive practice through expansion and repetitive exercises and are often based on materials and tasks that have little ecological validity (figures, words, shapes, tasks, tasks). It is one of the first approaches to memory rehabilitation. But at the moment it has few fans. Because, first of all, this approach is a garment for everyone and does not originate from a specific theory. Second, the materials used have little to do with the real world. Various evidences claim that the effect of exercises is limited to the practiced materials and cannot be generalized to the real world. Third, this approach assumes that exercise and stimulation will improve cognitive function by altering cognition and neuronal levels. However, no positive findings have been obtained in this regard (23).

Optimize residual performance

The aim of this approach is to find ways to optimize the use of damaged processes. Residual performance optimization assumes that normal cognitive processing mechanisms exist, but their efficiency is reduced and can be brought to an optimal level through educational interventions. The main emphasis of this approach is on empowering the individual to use the processes and skills of memory and attention that have been present before the disease. This approach is different from the performance restoration model because the goals are more specific and based on a theory. But here, as in the restorative approach, patients are encouraged to do the tasks they did before the injury. Most interventions in this framework focus on how individuals use memorization strategies and other techniques that have been proven to be effective for healthy maples. Because the current approach emphasizes the use of residual functions, it is very suitable for people with mild to moderate

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injuries. But it has also been criticized, as learning from optimization-based leaders is also limited to the context of education and is not generalizable. Thus, although individuals can learn to use encryption and retrieval strategies effectively, they cannot use them outside the context and with different materials. Therefore, teaching strategies will be useful only when used in important and everyday life situations (23).

Compensation for lost function

When brain damage is widespread and cognitive deficits are severe, cognitive rehabilitation often focuses on finding ways to help individuals replace or compensate for cognitive deficits. Therefore, with external support and environmental changes, people can be able to perform daily tasks and reduce the effects of disability. Interventions in this area are mainly at the behavioral level and do not include actions that affect the underlying cognitive and neurological processes. The strength of this approach is its widespread application and remarkable success in empowering individuals to achieve independence in day-to-day affairs. Although the use of external support is considered appropriate for people with severe injuries, it is also recommended for people with mild cognitive impairment and will work well in combination with other rehabilitation strategies. In using these strategies, it should be noted that external devices - such as notebooks and electronic devices - require extensive training before effective use, and this contradicts the abilities of patients (23).

Captain Log software

Captain Log software is one of the excellent cognitive software in the field of visual recognition, auditory recognition, number perception, consecutive conceptual patterns and types of memory (visual memory, auditory memory, working memory, memory sequence). This software initially conducts a 9-step test in two levels (children and adults) for the person and according to the specified age, the authorities report a report of acceptance of the person in each of the 9 stages of the test and a report of the average time to answer test questions. And provides a complete comparison chart for the examiner. In the next stage, the examiner will be able to use the treatment program recommended by the software according to the test performed or select a custom plan by the therapist from among about 50 types of exercises in 3 different levels (about 150 exercises). The age of use of this software is between 5 to 90 years old and outside the framework of cultural differences. This software provides a report of the progress and regression in the exercises to the therapist and is one of the best software used along with neurofeedback exercises, mental training exercises and various treatments for learning disabilities.

Captain Log software is an educational suite for enhancing higher cognitive functions and processes, and is a multi-dimensional cognitive rehabilitation tool capable of enhancing a wide range of cognitive functions. Improves mental and cognitive skills, increases self-esteem, self-efficacy and improves self-control. This collection has 2000 different programs and tasks at different levels, the most important parts of which are related to working memory and executive functions (6)

In this regard, the conceptual model of Captain Log software is based on the principle of brain flexibility. According to this principle, the brain of people, especially at a young age, has the ability to change and create new synapses, and Captain Log software can also create stable synaptic changes in the brain by repeatedly evoking inactive areas (forehead cortex).(10) and pave the way for behavioral change. A review of the research literature shows that Captain Log software is significantly effective in improving executive functions (Milton, 2010; Kesler & Lacayo, 2011). In the following, these researches are reviewed.

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Discussion

The issue of success in education is one of the most important concerns of the education system in all societies. Academic achievement refers to the ability learned or acquired in school subjects, which is measured by standardized learning tests or teacher-made tests and means the amount of individual learning in the school so that they can be categorized as factors related to individual differences and Factors related to school and education system were studied. Studies have shown that delays in executive functions increase the likelihood of adaptation and learning problems, and it is important to pay attention to these functions in order to improve students' performance in academic subjects. Executive functions are a set of cognitive abilities that are responsible for self-regulation and goal-oriented behaviors, enabling the individual to create new patterns of behavior and ways of thinking and reviewing thoughts. Dimensions of this structure are working memory, inhibition, programming and problem solving function, psychological flexibility and metacognition. Any defect or impairment in these functions can cause attention deficit, impairment of task memorization, impairment of planning for the beginning and end of the task, impairment of memory, and impairment of learning. Therefore, the selection of appropriate interventions to strengthen executive functions and promote students' academic achievement is an issue that must be addressed.

One of the therapies that has been used in recent years to improve executive functions and academic achievement is cognitive rehabilitation therapy. Cognitive rehabilitation refers to training that is based on the findings of the cognitive sciences and in the form of games (usually computer games) try to improve or enhance executive functions, all of which point to the principle of cognitive flexibility of the brain. Captain Log software, according to the principle of brain plasticity and self-healing, causes stable synaptic changes in the less active areas in the brain by successive excitation.

Conclusion

These programs have the ability to adjust the difficulty level of the task from simple to difficult based on individual differences and create ongoing cognitive challenges for the individual. Research in this field suggests that computer-assisted cognitive rehabilitation of working memory in students with learning disabilities, improving executive functions of response inhibition in children with attention deficit / hyperactivity disorder, improving memory, attention and executive functions in children of veterans in Studying at Shahed University, memory function and attention of students with diabetes, improving working and prospective memory function in patients with multiple sclerosis, improving response inhibition and planning ability in children with conduct disorder, working memory function in patients with traumatic brain injury ,Visual-spatial working memory function of students with math problems, response inhibition and persistent attention in children with attention deficit / hyperactivity disorder and executive functions of patients after stroke is effective. However, most previous studies have been performed on patients with chronic diseases, children and people with learning, behavioral and emotional problems, and the effect of this software on executive functions and academic achievement of high school students has not been studied. If it is necessary to pay attention to the executive functions in this group, considering their location in adolescence and the impact of this structure on emotional settings and emotional crises of this period, and its prominent role in academic success and the obvious importance of academic achievement in their future lives.

Resources

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