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The effect of training the cerebellum on the students' dyslexia symptoms

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Abstract

In this research, effects of training the cerebellum on reading symptoms on dyslexia students has been studied using the semi-experimental method. To carry out this study, 12 dyslexia students of Tehran's Hatef elementary school has been selected through teacher's introduction as an dyslexia student. After the pre-test (dyslexia test of KaramiNouri and Moradi), students were analyzed. Then, they have been under training during 32 sessions of motor and balance skills, sensory integrity and sensorimotor coordination. After these sessions, post-test (immediately after training) was performed and 10 dyslexia symptoms were compared by the use of two correlated group's t statistical model. The results showed that the cerebellum training was effective for the rhymes, picture naming, context perception, words perception, reading nonwords and pseudowords and letter signs tests,butit wasn't effective for words reading, words chain, phonemes exclusion and context signs test.so it can be suggested that the cerebellum training was effective on symptoms of dyslexia.

Keywords: cerebellum training, dyslexia, motor and balance skills, sensorimotor coordination

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Introduction

Hebb theory (1942) emphasizes on the importance of early motor-learning, as an integral part of the formation and development of brain cerebral cortex. Attention to the relationship between-motor learning, language and cognitive development in Russian researchers' works such as Luria (1946) is evident. Hence, it's not surprising that a number of theories of learning disabilityfocus their attention on the movement development and motor perceptual.Kephart (1960) is a developementalist, which based on the initial motor response, studies the children's behavior and believes that complex motor behaviors are formed on the basis of the behaviorsthat have less complexity. Kephart obtained the core concepts of learning and memory mostly from Hebb theories (1949). Hebb believes that in most cases, individual neurons are connected to each other by accident. Under certain circumstances stimulation of theseneurons will create vibrational activity that may continue for minutes or even days after the disappearance of the stimulus, the excitation can be facilitated through synaptic connections between two or more systems. Impulse that comes from one neuron could be a temporary facility, which in turn creates a weak circuit, so the more the vibrating action is repeated, the circuit facilitation becomes more.Hebb calls this vibrational circuit a cell assembly which eventually will cause anatomic changes and a permanent effect on memory (Sage, 1971).

Thus, according to Kephart, learning is effective and useful only when that perception and movement are together. It is a process that occurs through sensory experiences and different motor conditions. As a result, the perception and movement are linked together and act as one unit (Gearheart, 1973). With regard to the role of movement in children's lives and complexity of the movement, it seems as mobility becomes more advanced, factors such as perception, cognition, motivation, prerequisite skills, etc are considered as one of the basic fundamental skills for academic learning. Developing the cerebellar balance skills can reduce alexia. Some scientists believe that the balanced development of motor abilities forms the basis for future learning. A number of children with learning disabilities, despite their normal intelligence, in terms of movement balance are a lot slower than normal children in a waythat reforming their movement difficulties before other skills' trainings, is absolutely essential. It has been claimed that cerebellum plays a role in motor abilities automatisation and adaptive learning control. (Ito, 1984; Yankins Brooks; Nixon; Frachowiak; Passingham 1994)

Information is received by the senses and central nervous system and the brain coordinates them, in a way that the brain determines the relevant information interactions. After the organization of the information, brain controls our body and behavior.

Ayres (1973) defines the sensory integration as the internal organization of sensory organs in the brain and calls the produce of a response in accordance with the command of the brain, adaptive response. Ayres's research in the field was about learning disabilities of children. That is why her theory arises in relation to children who have a learning disability .The goal of sensory integration therapy is to improve the child in the sensory information processing and organizing. When the brain is able to organize sensory information, it leads to performance and life skills improvement, emotional development and general growth.These activities are not only useful for the brain, but also create a pleasant sensation, James Prescott and Robert Heath, two nerve Physiologists, from experiments on primates found that there is an emotional bond Between the cerebellum, the pleasure centers of the brain and emotional system.

McFall(1993) in their study, have insisted on the relationship between motor- cognitive skills, including hand and eye coordination, with academic achievement. From the same period of the sensory integration

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theory's creation, Ayres, like Getman and Kephart, emphasized on education development through movement and believed that the one of the detrimental factors in learning is sensory integration disorders that causes impaired perception(Ayres, 1973)

Perception is a concept between the child and its surroundings which gives the child the ability to interpret things and events and helps the child with the learning abilities (Arnheim and et al, 1973). Children are born with all the senses. From the moment of birth, a child has feeling, it sees, hears, can smell, taste and its sense of balance is active. At this time the muscles and joints, understand the movement directions and can sense movement. However, children should learn how to use their senses and nervous system should develop in order to work together.

Eye movement photography by the reading eye camera

Eye movement photographyprovides a recorded sample of reading performance proficiency for examination. The photography takes place when the reader moves the eyes along the printed lines from right to left (The text used is determined based on age and level of people's perception, Arnheim and et al 1973). In a one-year study on primary school children, they found that there is ahigh correlation between the movement ability measured by motor skills tests of frosting and consolidation, returns and reading comprehension measured by the reading eye camera.

Physiologists believe that the cerebellum work as a accurate movement coordinator by comparing the information obtained from cerebellar cortex with sensory information obtained from muscular activities and is able to make the necessary adjustments through lower motor neurons (Ayres, 1973). Reading is a cognitive challenge and a cultural invention of approximately 5,000 years ago and is imposed in the individual's cognitive system. Failure to learn readinghas become an important psychosocial issue. To read, the prerequisites of cognitive, auditory, visual and specificity linguistic are required. Any cognitive disruption is an obstacle for learning to read. Given that the reading is the basic and fundamental device for education and the failure in curricula, to a large extent, is related to incompetence in reading skills. Therefore, reading is a skill that is both essential and necessary in today's world.

Dyslexics have difficulty in the spontaneous formation of skills; this deficiency is linked with the cerebellum. Through reviewing different studies and using brain imaging in people with dyslexia, it has been identified that in 80% of cases the main cause of brain disorders in people with dyslexia is reading and writing defects (Nicolson andFawcett; 2007). Most neuromotor disordersare caused byinjuries that occurred during pregnancy, labor, birth or early childhood period. These injuries can have a wide range of damages and can be seen in the form of severe symptoms such as muscle contraction or lack of movement control or in the form of mild symptoms that can be observed in learning problems. Malfunctions in brain can be caused by different brain parts such as motor cortex, basal ganglia, or cerebellum which can be the results of a neurological lesion or growth retardation. A child who has brain damages mostly suffers from multiple disabilities and has 2 or more specific disorders. Also, brain damge can cause Intellectual disability, cognitive disabilities, learning disabilities, seizures and behavioral problems.

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Dyslexia is known as a disorder that has neurological origins. Observed abnormalities include defects in auditory and visual processing, altered lateral asymmetry of cerebellum, biochemical and histologic abnormalities in the cerebellum and altered and activator brain patterns (Rea, 2002).

Dyslexic children show evidence of cerebellar abnormalities. In addition, these children also have clinical signs cerebellar abnormalities (Fawest and Nicolson, 2001). Individuals who have cerebellar injuries show symptoms such as attention and working memory deflect (Malm J 1998) and dyslexia. When using normal intelligence tests commonly used to evaluate normal and dyslexic children,dyslexicsdon't do well in short-term memory evaluation tests (such as repeate immediately a group of numbers)

In comparing dyslexic and normal Cerebrum and cerebellumactivation patterns,some differences have been seen. In the normal group patterns of concentrated and bilateral activities in the frontal-parietal lobeand Ocsipitall area of the brain have been seen. While in the dyslexic group, it is spread unregulated and decentralized in Frontal-parietal lobe, Temporal and Ocsipitall area of cerebrum and cerebellum. The damage to cerebellum causes a variety of symptoms, including posture difficulty, balance, muscle stiffness, lack of coordination and movement fragmentation (Fawest and Nicolson, 2001). The proportion of gray material in the left lobe compared to the right cerebellar lobe in dyslexic people is different from those under the control in a study. This is due to the lack of left or right asymmetry in the controlled subjects in which didn't exist in reading disability. White material ratios shows symmetry in people with dyslexia and controlled without significant differences in the white material ratios among the groups and on the right lobe.

The symmetry of the cerebellum is related to the severity of the audio decoding defect in dyslexia. Cases of a more symmetrical cerebellumhave caused errors in standard capabilities of audio decoding of reading meaningless words. Ratios of metabolic material of the left lobehave been shown to link the asymmetry ratio of the cerebellum in controls. This relationship didn't exist in dyslexia. Cerebellum effect reflects the high levels of symmetry, which was previously found in temporal and parietal cortex when facing dyslexia. The cerebellum lack of asymmetry's relation in audio decoding ability along side of our previous discoveries about altered metabolic material ratio in the dyslexic cerebellum cause us to suggest that some changes in cognitive nerves system exist that are related to the audio decoding abilities, in addition to motor skills.Leiner and Dow have come to the conclusion that the role of cerebellum in language dexterity is vital.

Symptoms of dyslexia such as difficulty in having to navigate left and right, tiny drafting and coarse coding, having fingeragnosiaor the lack of sensory perception through finger's touch, incomplete or faulty eye movements during reading, having scores lower than average in verbal IQ and practical IQ, delay in language development, difficulty in naming objects, semantic errors, failure in pattern recognition time,should be taken into consideration. Also the symptoms of cerebellar damage in which muscles lose their senility against touch (exactly one of the symptoms of dyslexic children is losing the sensory-perceptive ability of their fingers) should be considered. Resistance to passive movements of the joints is reduced and the impact of the cerebellum on the stretch reflex disappears. Head often spins and bends and on the affected side, the shoulder is lower than the healthy side. When standing, the patient's legs are open

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wider than normal and they tighten their legs. The patient leans towards the damaged side when walking (same resource).

Muscle contraction is Delicate and irregular. This means that when performing delicate movements such as buttoning clothes or writing patient's hand, shakes. Muscle's groupFunction is lost and movement decompositionis caused. When the patient wants to touch the tip of the nose by the index finger, there is no coordination in the movement and the patient cannot put the heel on the other leg. The inability to perform rapid movements is seen in children with cerebellar damage. They lack the coordination of movements. A special attention is paid to the issue that many children with dyslexia show decreased responses of nystogmus and dizziness to balance stimulations (same resource).

The fact is that the dyslexic children show high sensitivity to high brain stimulation with balance triggers. The clinical impression is that the treatment is effective after the stimulation. Such treatment may enable neuronal communication.

Speech and learning, which is linked with the human connection in children, may be affected by impaired balance. Reading requires a healthy balance and efficient echolo motor centers. Dysartthria is a cerebellar disorder in which laryngeal muscles are affected with ataxia. Vocalization is reflexive and the syllables of a word often expressed separately. Speech is in explosive form and syllables are often expressed vaguely.

There are no motor sensory changes in cerebellar damage although, there may be inconsistencies. This disorder is not limited to muscle or group of muscles and whole organs or half of the body is involved. If both hemispheres of the cerebellum are involved, disorder in the activity of all body muscles may be seen. There's no atrophy, but muscle contractions may be weak and he patient get tired fast (same resource).

So if the cerebellar damage exists, dyslexic children should show signs of cerebellar dysfunction. Consistent with these studies and by comparing normal and dyslexic children we realize that significantly, all four groups of dyslexics have disabilities in standing sustainability skills and muscle movements (same resource).

Some scientists believe that the balanced development of motor abilities forms the basis for future learning. A number of children with learning disabilities, despite their normal intelligence, in terms of movement balance are a lot slower than normal children in a way that reforming their movement difficulties before other skills' trainings, is absolutely essential.

It has been claimed that cerebellum plays a role in motor abilities automatisation and adaptive learning control. (Ito, 1984; Yankins Brooks; Nixon; Frachowiak; Passingham 1994)
Leiner and Dow have come to the conclusion that the role of cerebellum in language dexterity is vital. Speech and learning, which is linked with the human connection in children, may be affected by impaired balance. Reading requires a healthy balance and efficient echolo motor centers.
In a recent meta-analysis study about the dual root of reading which has been performed from 35 nerve cells images, it was found that, although it has been proven that areas like the cerebellum are activated during reading, but their role has been rarely focused on researchs.

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In most diagnostic systems, communication and learning disorders as well as impaired motor skills are known as a developmental disorder. On the other hand, learning disorders in terms of the skills that are taught in school, such as reading, mathematics and writing are different than other developmental disorders. Impairment exists in one or more of the basic psychological processes, such as perception or using language, speaking and writing which are reveal themselves in forms of imperfect ability to listen, think, speak, read, write, spell or doing mathematical calculations. This term includes conditions such as cognitive defects, minor brain dysfunction, developmental aphasia, Dyslexia and learning disabilities. But it doesn't include children whose disabilities are primarily the result of visual defects, hearing, motor, intellectual disability, emotional, environmental cultural disturbance, or economic losses. There are other definitions of learning disability, for example, the national participation committee states: learning disability is a general term that refers to a heterogeneous group of disorders characterized by difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or Acalculia. This disorder has interpersonal aspects (one's own). It is assumed that it is associated with the dysfunction of the central nervous system and will be present throughout one's life. Although learning disabilities may be accompanied by other conditions that may be causing disabilities (e.g., sensory impairment, mental retardation or severe behavioral disorders) or be a result of environmental influences, but is not directly caused by such conditions (Hammil, 1990).

Various researches in the areas of specific learning disability refer to two categories which areDereiopmintal learning disability and Academic learning disability (Fawest and Nicolson, Ramezani translation). Based on this categorization, visual perception and visual-motor dysfunction, impaired auditory processing techniques, memory impairment, attention disorders, developmental, biological disorder and listening disorder are placed in learning and developmental disorder class. Some researchers believe that, basic psychological process disruption leads to formation of problems in school acquisitions. The second group of school learning disability is placed in the area of language and reading disability, writing disability, the inability to spell, mathematics, and executive dysfunctions (same resource.). In the last division of the learning disorder, a new class has been added to the two previous classes, which is maladjustment. This class also has three distinct subgroups, which include poor self-perception, conflicted behavior and low motivation.

Research shows that children with learning disorders enter school with a set of developments problems in the field of information processing. These studies indicate that emotional problems in children with learning disorders are more common than in normal people with and learning disability can also be effective in emotional problems.

Research methods and research questions

Research method is a semi-experimental method with pre-test and post-test. A semi-experimental, scientific research is usually used in a real community. In these circumstances, there is no possibility of controlling all variables and possibly researcher can only control some of them. The first measurement is done by performing a pre-test and second measurement with a post-test. Researcher has used random sampling method among students in order to form the groups. The dependent variable measurement for both of them is done at the same time and under the same conditions.

The study population includes all dyslexic students in primary school of Hatef in the 6th district of Tehran city in the school year of 91-92.

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The sample size in this study is 12 dyslexic primary Hatef school students in Tehran which are placed a test group (12 people).

The goal is to reduce the symptoms such as difficulty in navigating left and right, tiny drafting and coarse scripting, finger agnosia or lack of sensory perception by finger touch, incomplete or faulty eye movement during reading, naming objects disorder, semantic errors (Piruzulu M., 1987), time pattern detection disability with balance and cerebellum exercises (McGarion, 1991) and the dyslexic children will be able to achieve skills such as navigation, eye and hand coordination, sensory perception abilities, sensory motor skills, visual perception skills, visual chasing ability.

The research questions are stated as follows:

Does cerebellum training reduce dyslexia symptoms in primary grade students?

How much cerebellum training effect students' reading skills?

How much cerebellum training effect the students' words chain recognition skills?

How much cerebellum training effectstudents' words rhyme recognition?

How much cerebellum training effectstudents' image naming skills?

How much cerebellum training effectstudents' word and text comprehension skills?

How much cerebellum training effectstudents' phoneme elimination skills?

How much cerebellum training effectstudents' non-words and pseudowords reading skills?

How much cerebellum training effectstudents' sign letter recognition?

How much cerebellum training effectstudents' concept sign recognition?

Questionnair analyze results

The results of static tests are as followed:

Table 1: static indices related to studying the variable (words reading)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Standard error	Deviation Coefficient	Kurtosis Coefficient
Pre- test	21	58.50	50.41	58	544.62	23.33	6.73	-0.52	-0.68
Post-test	21	53	48.16	60	610.87	24.71	7.13	-0.12	-0.02

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

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Table 2: static indices related to studying the variable (words chain)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	63	74.50	74.75	22	53.65	7.32	2.11	-0.16	-0.46
Post-test	72	76.50	77.58	17	29.90	5.46	1.57	0.76	-0.29

Table 3: static indices related to studying the variable (rhyme test)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	72	78.50	80.25	33	111.29	10.54	3..04	0.48	-0.97
Post-test	94	95.50	95.08	47	220.99	14.86	4.29	0.12	-0.72

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 4: static indices related to studying the variable (naming images)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	96	96	92	114	1268.54	35.61	10.28	-0.06	0.30
Post-test	112	119.50	108.50	89	797	28.23	8.14	-.015	0.10

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According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 5: static indices related to studying the variable (text comprehension)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	9	33	36.16	95	850.87	29.16	8.42	0.14	-1
Post-test	20	65	53.83	77	893.24	29.88	8.62	-0.26	-0.93

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 6: static indices related to studying the variable (words perception)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	6	66	65.66	50	256.60	16.01	4.62	0.17	-0.11
Post-test	49	78	74.33	73	461.15	21.47	6.19	0.14	-0.37

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 7: static indices related to studying the variable (phoneme elimination)

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Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	72	72	73.25	36	128.20	11.32	3.26	0.62	-0.02
Post-test	69	76	80.25	45	193.11	13.89	4.01	0.26	-0.98

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 8: static indices related to studying the variable (reading non-words and pseudo-words)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	32	54	53.25	82	482.56	21.96	6.34	0.03	0.55
Post-test	67	67	66.16	75	340.33	18.44	5.32	0.07	0.31

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 9: static indices related to studying the variable (letter signs test)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	67	72.50	74.83	20	57.42	7.57	2.18	0.33	-0.57

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Post-test	77	84	83.25	19	42.38	6.51	1.87	-0.20	-0.25

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 10: static indices related to studying the variable (concept signs tests)

Stage	Measures of Central Tendency			Dispersion Indices			Distribution Indices		
	View	Median	Average	variation range	Variance	Standard Deviation	Average	Standard error	Deviation Coefficient
Pre- test	70	73	92.50	68	939.72	20.65	8.84	0.81	-0.57
Post-test	68	72.50	92.33	70	1022.24	31.97	9.22	0.72	-0.67

According to table above and considering that there is a small difference between values of view, median and average, and since the deviation coefficient and kurtosis coefficients are below 1, it can be said that the above distribution can be considered as a normal distribution. So the average value can be used as referral of measures of central tendency and the parametric statics models can be used.

Table 11: The impact of cerebellum training on (words reading) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	50.41	23.33	0.53	11	0.606
Post-test	48.16	24.71			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.05$, there is no significant difference between students averages in (words reading). Therefore, it is concluded that cerebellum training doesn't affect (words reading) in students.

Table 12: The impact of cerebellum training on (words chain) in tow Correlated groups of students for analyzing

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Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	74.75	7.32	-1.93	11	0.079
Post-test	77.58	5.46			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.05$, there is no significant difference between students averages in (words chain). Therefore, it is concluded that cerebellum training doesn't affect (words chain) in students.

Table 13: The impact of cerebellum training on (rhyme test) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	80.25	10.54	-4.23	11	0.001
Post-test	95.08	14.86			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.01$, there is a significant difference between students averages in (rhyme test). Studying the averages in two stages indicates that the average in the post-test has increased, therefore it is concluded that cerebellum training affects (rhyme test) in students.

Table 14: The impact of cerebellum training on (naming images) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	92	35.61	-3.07	35.61	92
Post-test	108.50	28.23			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.01$, there is a significant difference between students averages in (naming images). Studying

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averages in two stages indicates that the average in the post-test has increased, therefore it is concluded that cerebellum training affects (naming images) in students.

Table 15: The impact of cerebellum training on (text comprehension) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	36.16	29.16	-3.56	11	0.004
Post-test	53.83	29.88			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.01$, there is a significant difference between students averages in (text comprehension). Studying averages in two stages indicates that the average in the post-test has increased, therefore it is concluded that cerebellum training affects (text comprehension) in students.

Table 16: The impact of cerebellum training on (words perception) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	74.75	7.32	-1.93	11	0.079
Post-test	77.58	5.46			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.05$, there is a significant difference between students averages in (words perception). Studying averages in two stages indicates that the average in the post-test has increased, therefore it is concluded that cerebellum training affects (words perception) in students.

Table 17: The impact of cerebellum training on (phoneme elimination) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	73.25	11.32	-2.10	11	0.06

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Post-test	80.25	13.89			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.05$, there is no significant difference between students averages in (phoneme elimination). Therefore, it is concluded that cerebellum training doesn't affect (phoneme elimination) in students.

Table 18: The impact of cerebellum training on (reading non-words and pseudo-words) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	53.25	21.96	-3.51	11	0.005
Post-test	66.16	18.44			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.01$, there is a significant difference between students averages in (reading non-words and pseudo-words). Studying averages in two stages indicates that the average in the post-test has increased, therefore it is concluded that cerebellum training affects (reading non-words and pseudo-words) in students.

Table 19: The impact of cerebellum training on (letter signs test) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	74.83	7.57	-4.51	11	0.001
Post-test	83.25	6.51			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.01$, there is a significant difference between students averages in (letter signs test). Studying averages in two stages indicates that the average in the post-test has increased, therefore it is concluded that cerebellum training affects (letter signs test) in students.

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Table 20: The impact of cerebellum training on (concept signs tests) in tow Correlated groups of students for analyzing

Stage	Average	Standard Deviation	t value	Degrees of freedom	The significance level
Pre- test	92.50	30.65	0.14	11	0.889
Post-test	92.33	31.97			

According to table above and considering the measured t value, it can be said that, in the level of $\alpha = 0.05$, there is no significant difference between students averages in (concept signs tests). Therefore, it is concluded that cerebellum training doesn't affect (concept signs tests) in students.

Conclusion

Given that in this study, the effect of cerebellum training on students' dyslexia has been analyzed, the dyslexia test which is consist of 10 small test including words reading, words chain, rhyme test, naming images, text comprehension, words perception, phoneme elimination, reading non-words and pseudo-words, letter signs test and concept signs tests has been performed. All the small tests have been measured by converting the raw numbers to balance, which all of them were quantitative and Continuous. Therefore, first the normality of mentioned variables distributions were studied using the descriptive statistics (central tendency, dispersion and distribution) and then after confirming the normality of data, the t statistic model of two correlated groups were used for comparing the averages of pre-test and post-testand the effect of cerebellum training on 10 signs of dyslexia were studied.

Results shows that cerebellum training had a impact on rhyme test, naming images, text comprehension, words perception, reading non-words and pseudo-words and letter signs test and there was a significant difference between averages of pre-test and post-test. Whilst, cerebellum training had no a impact on words reading, words chain, phoneme elimination and concept signs tests and there was no significant difference between averages of pre-test and post-test. Since, the average of post test has been increased, thus, it can be concluded that cerebellum training has a impact on dyslexia and increases the rhyme test, naming images, text comprehension, words perception, reading non-words and pseudo-words and letter signs test in students.

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