

THE EFFECT OF BRAIN-BASED ADAPTABLE PHYSICAL ACTIVITIES ON THE DEVELOPMENT OF BALANCE SKILLS OF CHILDREN WITH AUTISM

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ABSTRACT

As in there are new and different developments in the field of education of normal people in the world, many education methods are being developed because individuals with autism have different characteristics. Brain-based education is one of these types of education. It is known that brain-based physical activities that facilitate movement training, improve motor coordination are accelerate learning, and have positive effects on individuals, especially in children.

The research was carried out to determine the effect of brain-based adapted physical activities on the development of balance skills of children with autism. One of the single-subject research models, the probe-phased multiple probe model was used. The population of the study consists of children with mild autism between the ages of eight (8) and ten (10) living in the province of Isparta. The sample of the study, on the other hand, consists of three (3) children, determined by the simple random sampling method, among the children of the families who formed the universe and agreed to participate in the study voluntarily.

The research lasted for a total of thirteen (13) weeks, one (1) week of observation and twelve (12) weeks of practice. During the research, the same education program was applied to all three children. It was aimed to teach activities that include basic body movements such as squatting-standing, walking forward and backward, running, jumping with one foot and two feet the children participating in the study.

Child body coordination test was used in data collection. The test is used in studies aiming to obtain data on the motor coordination levels of children aged 5-14 years and their social, psychomotor, psychological and healthy life levels in general. It consists of four sub-dimensions such as one foot hop, Back balance and Side jump.

The data obtained at the end of the application were analyzed by showing them on the graph. Due to the fact that the number of participants participating in the research was three (3), the data obtained in the twelve (12) week period was converted into a dot score in accordance with the scale protocol and turned into a line chart to reveal the change that occurred (Özdamar, 2013).

While the children could not perform the desired behaviors independently before starting the training, it was observed that they were able to perform the desired movements independently when they were given the opportunity to repeat with intermittent repetitions the activities that prepared and applied according to children's developmental levels.

It has been concluded that the adapted brain-based movement training program is effective in the development of psychomotor skills such as attention, balance and coordination in children with mild autism.

Keywords: Brain-based exercise, Autism, Balance, Adapted activity

Introduction

As in there are new and different developments in the field of education of normal people in the world, many education methods are being developed because individuals with autism have

different characteristics. Brain-based education is one of these types of education. It is known that brain-based physical activities that facilitate movement training, improve motor coordination, accelerate learning, and have positive effects on individuals, especially in children (Çimen, 2021). When the effects of brain-based physical activities are examined; It is known that it reduces stress, brings relaxation, provides an active memory and concentration, a very fast and high-quality learning, an increase in self-confidence thanks to the improvement in physical and mental performance, and less mistakes. It is known that brain-based physical activities contribute to the creation of new and different nerve learning pathways in the brain by combining intellectual contents in a synchronized and active manner as a pattern and whole (Lutz, 2014). Brain-based physical activities are a training model that aims to combine cognitive exercises and motor coordination exercises. Motor coordination exercises aim to process multiple skills at the same time (Demirakca, Cardinale, Dehn, Ruf, and Ende, 2016). When brain-based exercises and trainings are examined, it is known that they are effective on physiological and psychological characteristics such as Perception, Memory, Cognitive Abilities, Flexible Body Control, Visual Perception, Visual System, Attention. On the other hand, in addition to brain-based physical activities, attention is an important condition for children in their learning processes.

Although children and adults have developed brains, their attentional capacities are limited. In this respect, it is very important for learning to take place fully. The realization of a permanent learning is possible by the individual's attention to information coming from the environment or the outside world. In gaining attention, stimulant and information about the person themselves become important (Öztürk, 2020). It is known that various movements in fun and cheerful brain-based education and physical activities are beneficial, especially for children with learning difficulties or attention deficit. Movement, which is an important part of physical, mental and emotional development, is one of the indispensable activities of the child. Diseases are seen as a risk in their lives in children who adopt a sedentary lifestyle (Kerkez, 2012). It is known that movement training is one of the most effective and important forms of education that supports perceptual development and is used to correct perceptual disorders in the lives of individuals (Çamlıyer, 1994). It is thought that the brain-based movement trainings used are also effective in individuals with special needs. Parents of children born with special needs make every effort to ensure that their children can lead their lives comfortably and self-sufficiently. The first expectation of parents of children with autism is to have a perfect child who will be a completely independent individual when they grow up (Wing, 2015). Autism Spectrum Disorder is a disorder that starts in infancy and childhood and causes repetitive behaviors that harm the cognitive intelligence of individuals throughout their lives (Darica et al., 2005). Autism is called a neurodevelopmental disorder that negatively affects the level of social development and behavioral problems in addition to communicating in people's lives (Ruştioğlu et al., 2018). Children with autism may have different problems. There are accompanying problems that affect children with autism at different levels, and children with various and different abilities are seen according to their age and developmental level (Günel and Bumin, 2007). It is important to reveal all the characteristics of children with autism spectrum disorder (ASD), to complete the early diagnosis and diagnosis processes, and to fully identify any behavioral disorders that may occur, in terms of determining the right education methods for children (Yıldırım, 2020). It is observed that children with autism lag behind normal children in terms of movement, strength, control and speed, especially balance (Orhan, 2014). It is known that children with autism who have balance problems have difficulty in moving. Sports, which is one of the techniques used in rehabilitating autism, enables individuals with autism to participate in social life and has positive effects in reducing health problems. The causes of autism and the measures that can prevent it have not been found yet (Yaman et al., 2020). It has been

determined that sports activities have positive effects, a solution has been found by reducing the problems of autism thanks to sports activities, and it has become a priority choice (Karakuş, 2012). When the literature is examined, there are various studies on brain-based education (Neureuther, 2015; Wienecke, Nolden, 2010, Penka, 2009; Haas, Scholz, 2011; Grünke, 2011) and studies examining the level of participation in physical activity in children with autism (Healy, Haegele, Grenier and Garcia, 2017; McCoy, Jakicic and Gibbs, 2016; Cai and Kornspan, 2012). It is important to include brain-based adapted physical activity practices that contribute to the cognitive, social, communication, motor and emotional development of individuals with ASD and to improve their motoric characteristics.

In the light of all this information, it is aimed to examine the effect of brain-based adapted physical activities on the development of balance skills of children with autism.

Methodology

Model of the Research

One of the single-subject research models, the probe-phased multiple probe model was used (Özdamar, 2003).

Research Group

The population of the study consists of children with mild autism between the ages of eight (8) and ten (10) living in the province of Isparta. The sample of the study, on the other hand, was formed with three (3) children who were determined by simple random sampling method among the families who formed the universe and agreed to participate in the study voluntarily. Written consent was obtained from the families of the children to have the selected children do physical activities.

Study Time and Intended Skills

The research lasted for a total of thirteen (13) weeks, one (1) week of observation and twelve (12) weeks of practice. During the research, the same education program was applied to all three (3) children. It was aimed to teach activities that include basic body movements such as squatting-standing, walking forward and backward, running, jumping with one foot and two feet the children participating in the study.

Data Collection Tools

Child Body Coordination Test

The child body coordination test (CBCT) or the German version (KTK: Körperkoordinations Test für Kinder) was developed by Kiphard and Schilling (1974) and modernized in 2007, the test is known as “KTK” in the literature. The test was planned to evaluate the coordination and movement adequacy of children between the ages of 5-14 (Kiphard & Schilling, 2007).

(CBCT) It is used in studies aiming to obtain data on the motor coordination levels of children and their social, psychomotor, psychological and healthy life levels in general. The motor coordination test for children is a very reliable ($r=0.85$) and valid ($r=0.60-0.80$) measurement tool in terms of assessing motor skills (Kiphard & Schilling, 2000; Livonen, Saakslanti, & Laukkanen, 2016). It consists of four sub-dimensions such as stepping sideways (with a platform), one-foot bounce, backward balancing and sideways jumping (Özkara, 2018).

Data Analysis

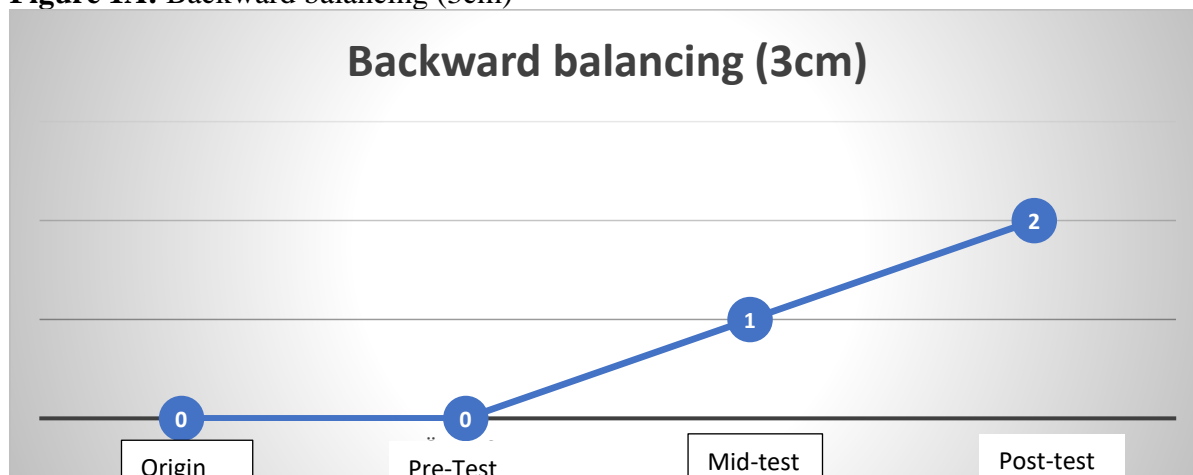
The data obtained at the end of the application were analyzed by showing them on the graph. Due to the fact that the number of participants participating in the research was three (3), the data obtained in the twelve (12) week period was converted into a dot score in accordance with the scale protocol and turned into a line chart to reveal the change that occurred (Özdamar, 2013).

Results

In this section, there is a graphical analysis of the data obtained for the balance skills of the children participating in the research. In order to respect the cause of personal rights, the names and surnames of the children are not written clearly. Children were coded as Participant 1, Participant 2, Participant 3.

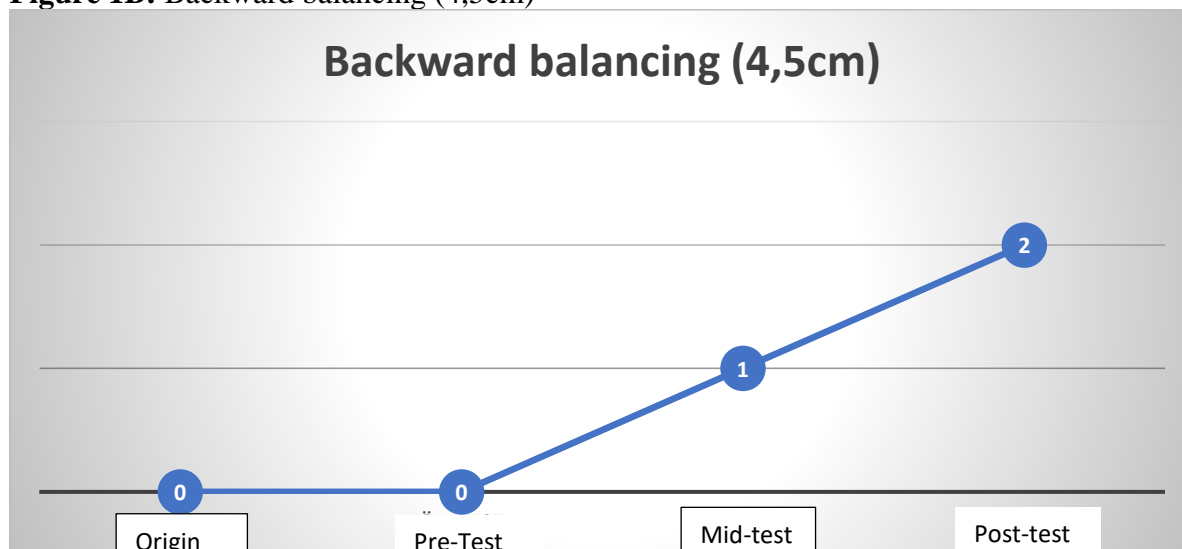
Balance skill results of participant 1

Figure 1A: Backward balancing (3cm)



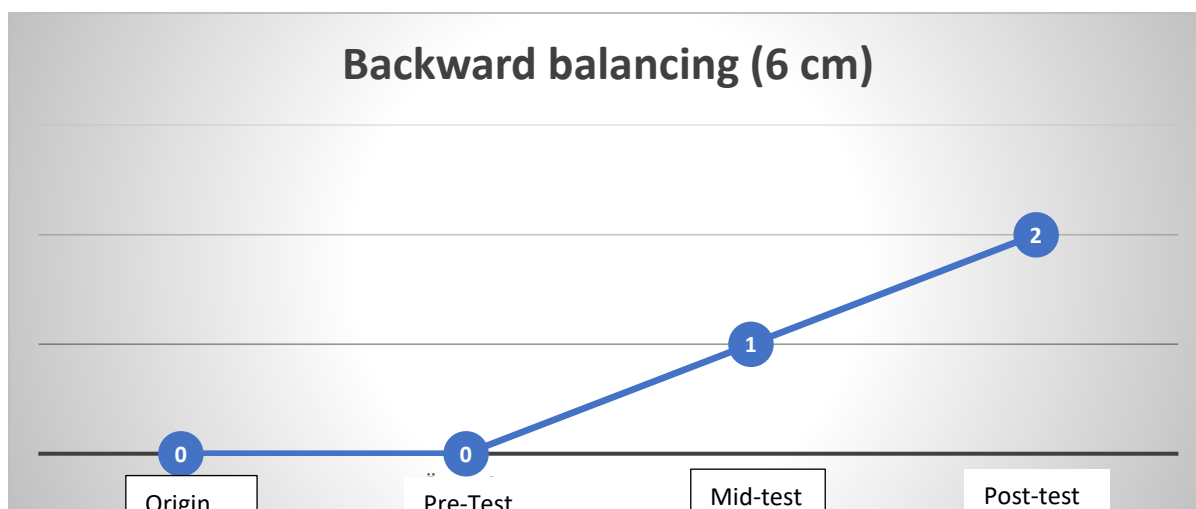
According to Figure 1A, when the initial level and pre-test results are taken into account, it is seen that the child cannot perform *the backward balancing (3cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement once (1) as desired. Considering the post-test results, it is seen that the child can do the same movement twice (2) as desired.

Figure 1B: Backward balancing (4,5cm)



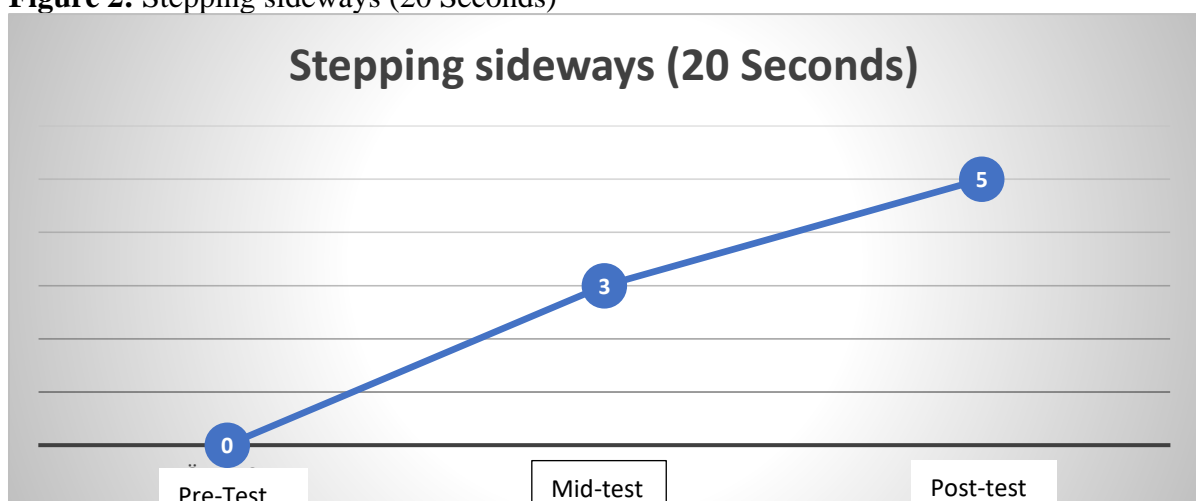
Looking at Figure 1B, when the initial level and pre-test results are taken into account, it is seen that the child cannot perform *the backward balancing (4.5 cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement once (1) as desired. Considering the post-test results, it is seen that the child can do the same movement twice (2) as desired.

Figure 1C: Backward balancing (6 cm)



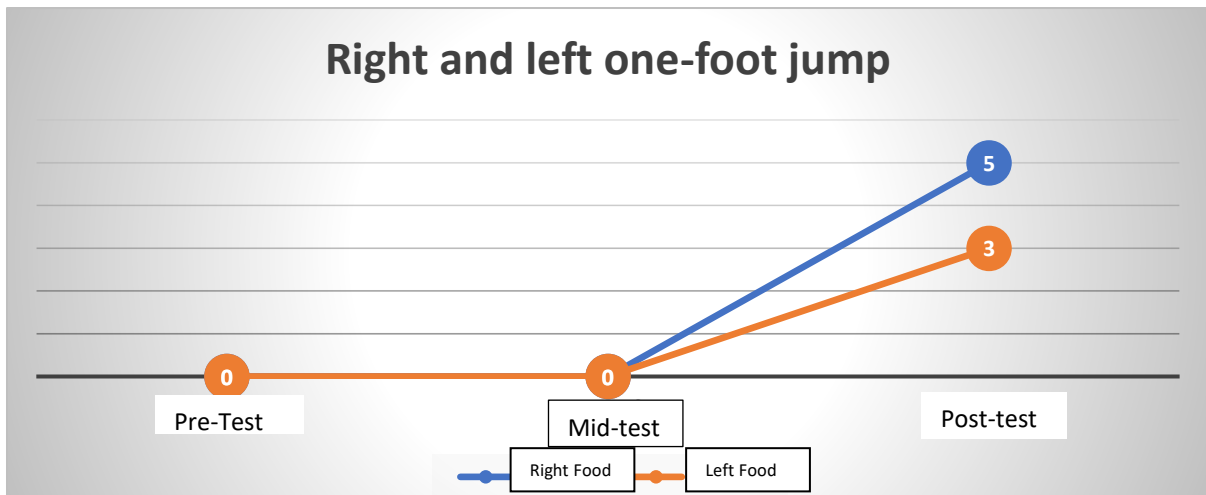
Looking at Figure 1C, considering the initial level and pre-test results, it is seen that the child cannot perform *the backward balancing (6cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement once (1) as desired. Considering the post-test results, it is seen that the child can do the same movement twice (2) as desired.

Figure 2: Stepping sideways (20 Seconds)



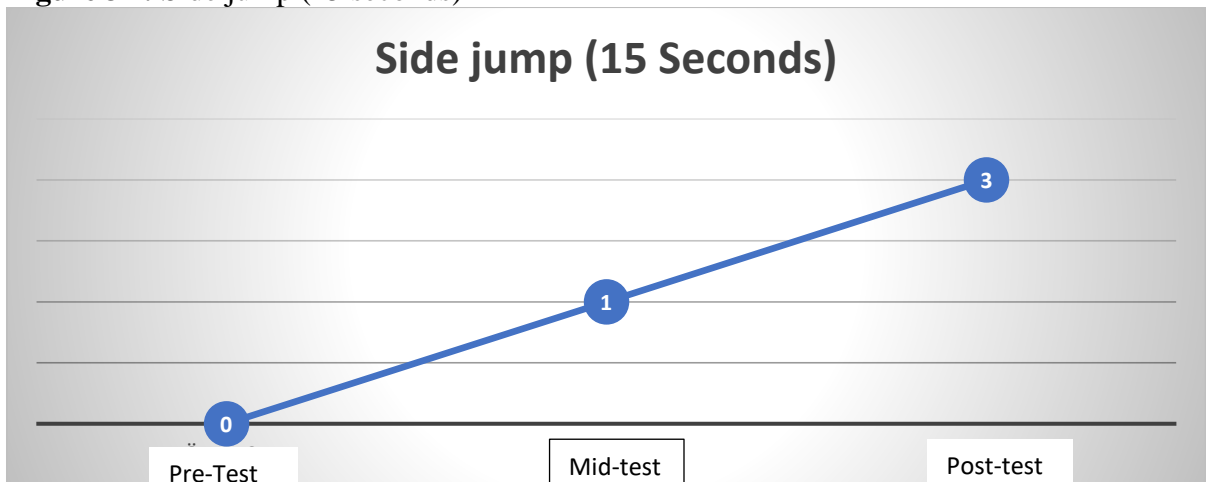
Considering the pre-test results in Figure 2, it is seen that the child could not perform *the sideways stepping (20 seconds)* movement in accordance with the rules. Considering the mid-test results, it is seen that the child can do the movement three (3) times as desired. Considering the post-test results, it is seen that the child can do the same movement five (5) times as desired.

Figure 3A: Right and left one-foot jump



Considering the pre-test and mid-test results in Figure 3A, it is seen that the child could not perform *the right and left foot jumping* movements in accordance with the rules. Considering the post-test results, it is seen that the child can perform the same movement five (5) times with the right foot and three (3) times with the left foot in accordance with the rules.

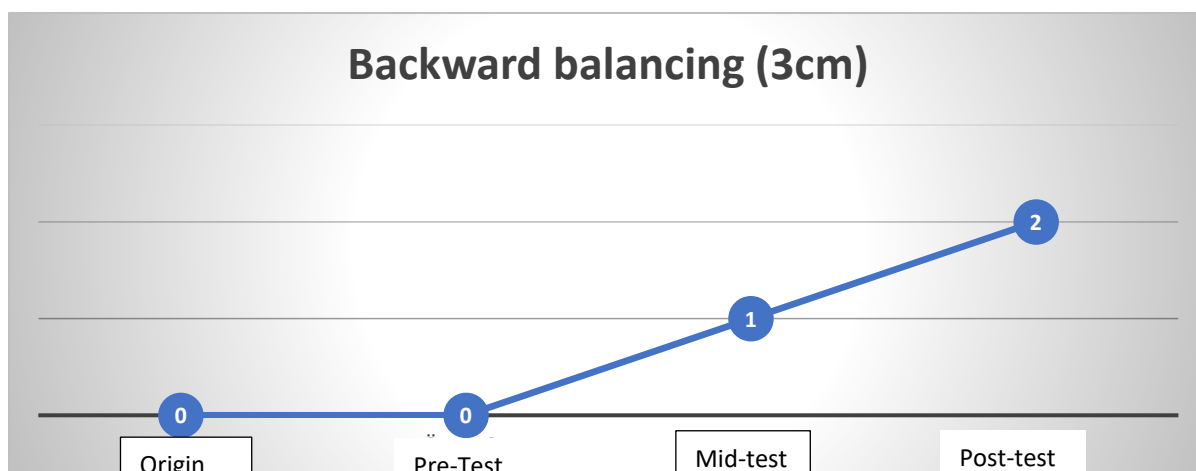
Figure 3B: Side jump (15 seconds)



Considering the pre-test results in Figure 5, it is seen that the child could not perform *the sideways stepping (20 seconds)* movement in accordance with the rules. Considering the mid-test results, it is seen that the child can do the movement three (3) times as desired. Considering the post-test results, it is seen that the child can do the same movement five (5) times as desired.

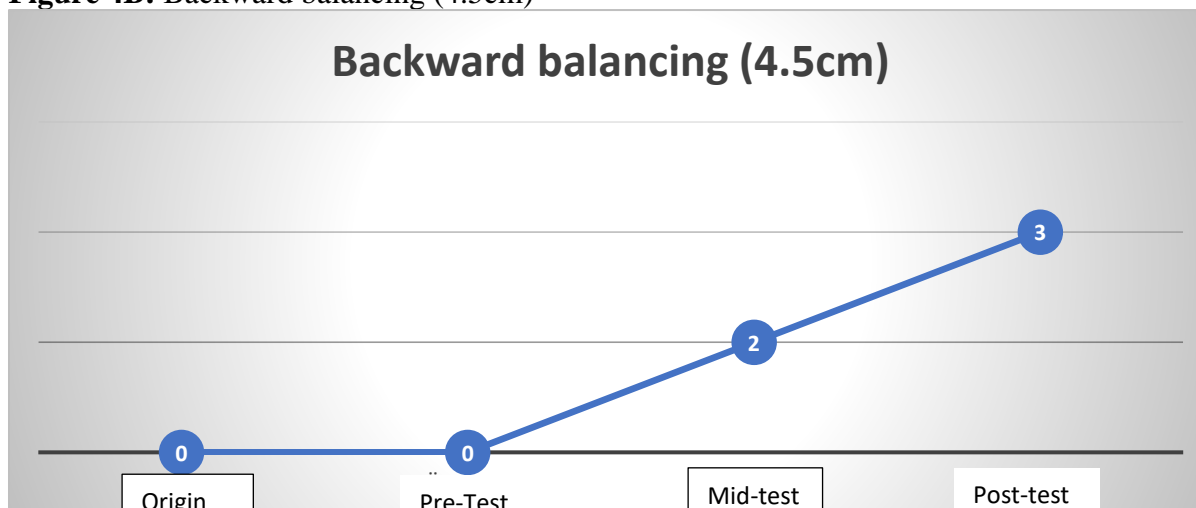
Balance skill results of participant 2

Figure 4A: Backward balancing (3cm)



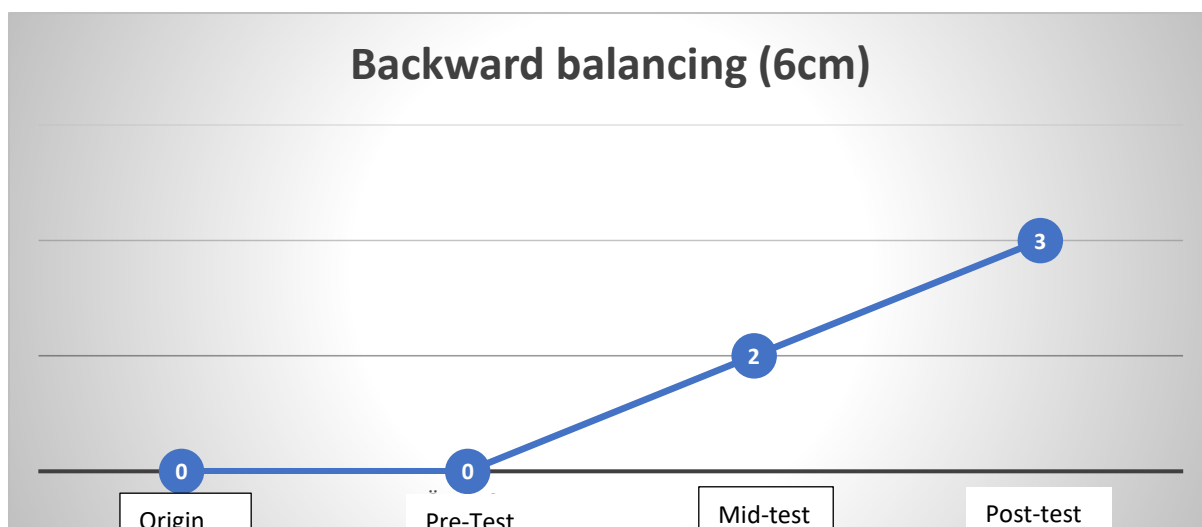
Looking at Figure 4A, considering the initial level and pre-test results, it is seen that the child could not perform *the backward balancing (3cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement once (1) as desired. Considering the post-test results, it is seen that the child can do the same movement twice (2) as desired.

Figure 4B: Backward balancing (4.5cm)



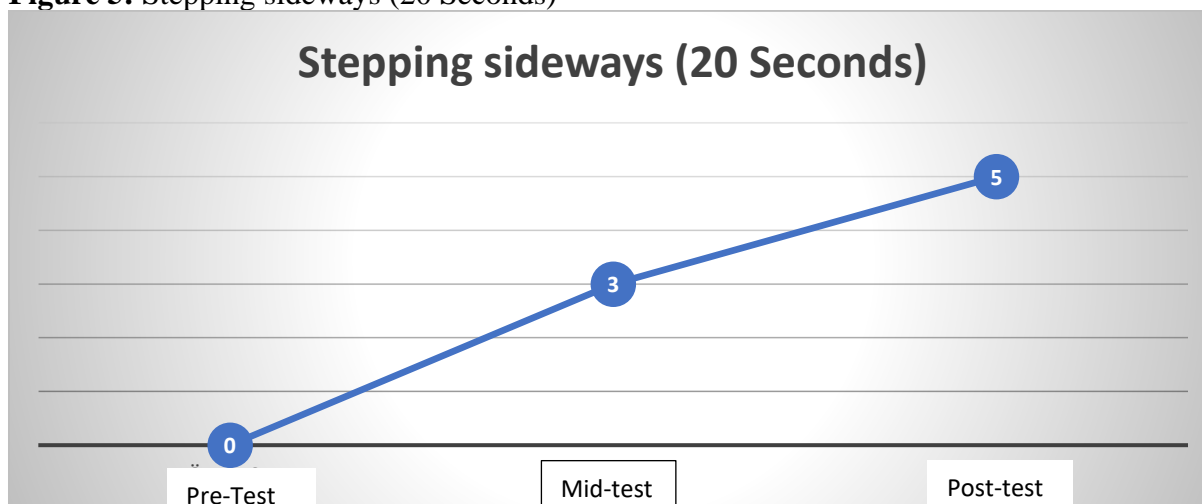
Looking at Figure 4B, when the initial level and pre-test results are taken into account, it is seen that the child cannot perform *the backward balancing (4.5 cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement two (2) times as desired. Considering the post-test results, it is seen that the child can do the same movement three (3) times as desired.

Figure 4C: Backward balancing (6cm)



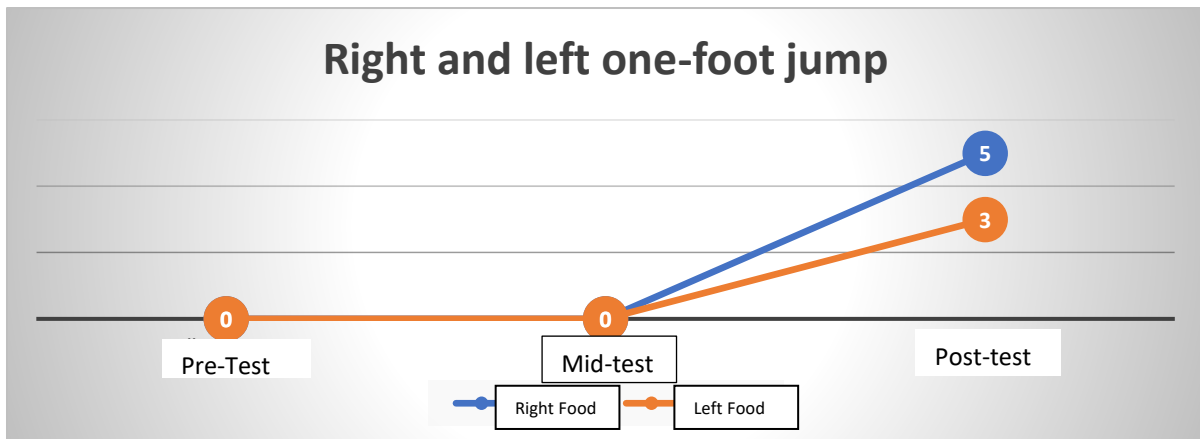
Looking at Figure 4C, considering the initial level and pre-test results, it is seen that the child could not perform *the backward balancing (6cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement two (2) times as desired. Considering the post-test results, it is seen that the child can do the same movement three (3) times as desired.

Figure 5: Stepping sideways (20 Seconds)



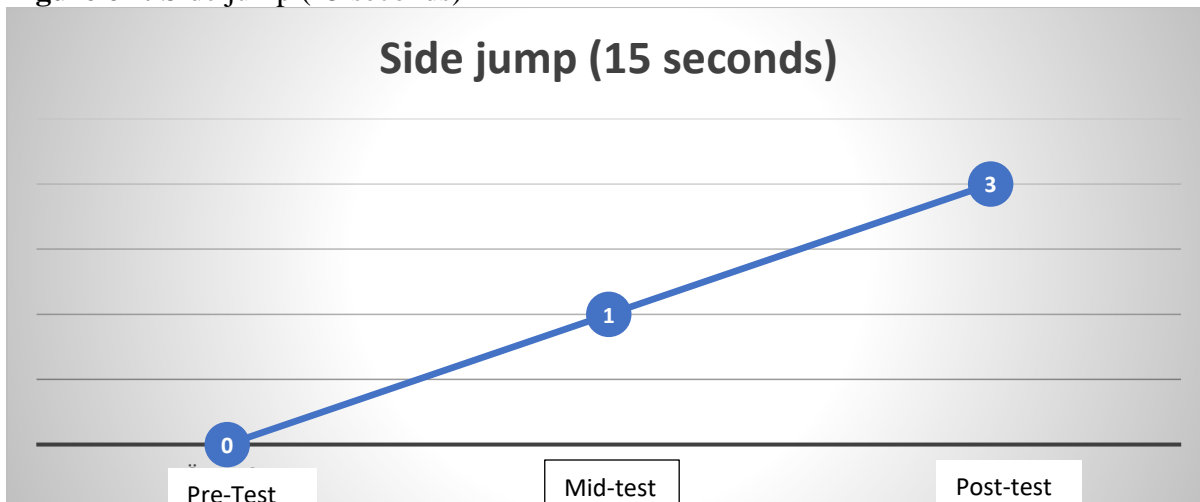
Considering the pre-test results in Figure 5, it is seen that the child could not perform *the sideways stepping (20 seconds)* movement in accordance with the rules. Considering the mid-test results, it is seen that the child can do the movement three (3) times as desired. Considering the post-test results, it is seen that the child can do the same movement five (5) times as desired.

Figure 6A: Right and left one-foot jump



Considering the pre-test and mid-test results in Figure 6A, it is seen that the child could not perform *the right and left foot jumping* movements in accordance with the rules. Considering the post-test results, it is seen that the child can perform the same movement five (5) times with the right foot and three (3) times with the left foot in accordance with the rules.

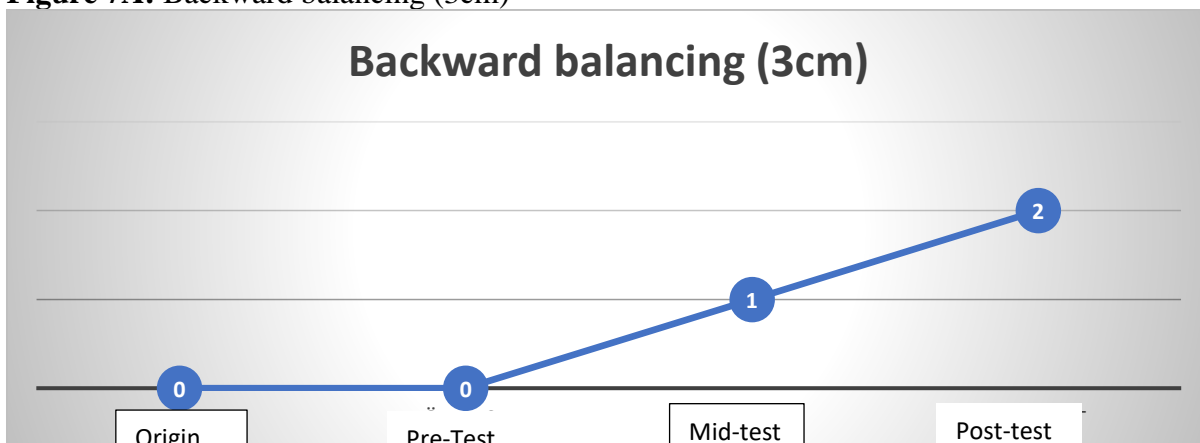
Figure 6B: Side jump (15 seconds)



Considering the pre-test results in Figure 6B, it is seen that the child could not perform *the side-jump (15 seconds)* movement skills. Considering the mid-test results, it is seen that the child can perform the movement as desired once (1). Considering the post-test results, it is seen that the child can do the same movement three (3) times as desired.

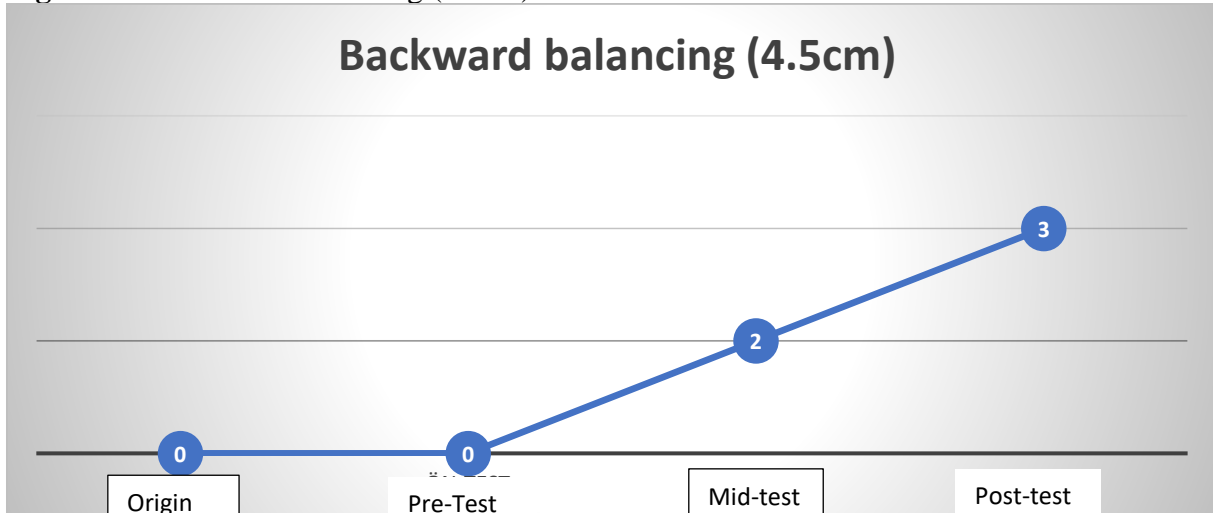
Balance skill results of participant 3

Figure 7A: Backward balancing (3cm)



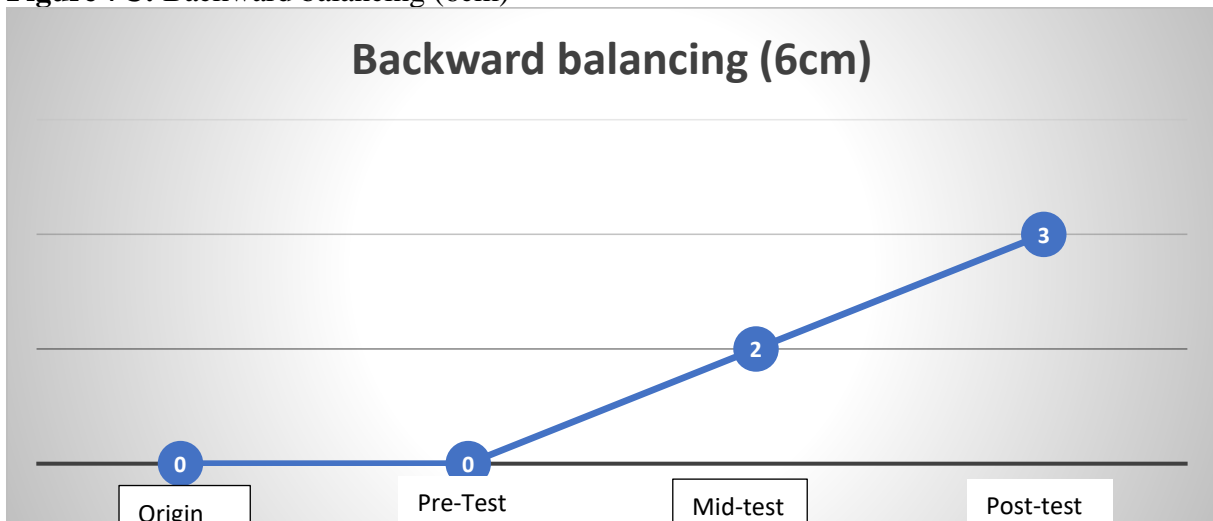
Looking at Figure 7A, considering the initial level and pre-test results, it is seen that the child cannot perform *the backward balancing (3cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement once (1) as desired. Considering the post-test results, it is seen that the child can do the same movement twice (2) as desired.

Figure 7B: Backward balancing (4.5cm)



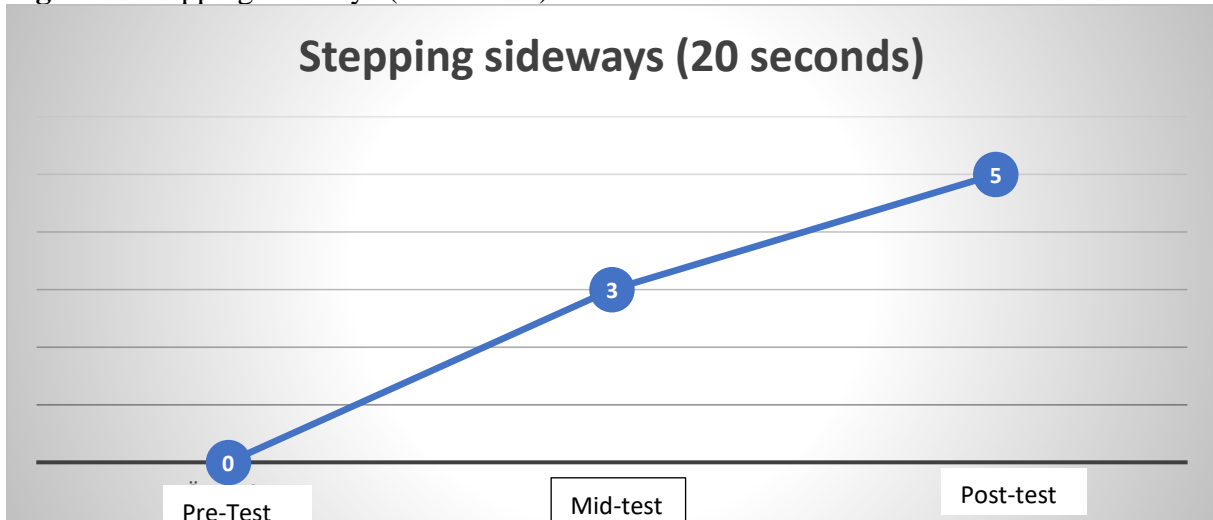
Looking at Figure 7B, considering the initial level and pre-test results, it is seen that the child cannot perform *the backward balancing (4.5 cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement two (2) times as desired. Considering the post-test results, it is seen that the child can do the same movement three (3) times as desired.

Figure 7C: Backward balancing (6cm)



Looking at Figure 7C, considering the initial level and pre-test results, it is seen that the child cannot perform *the backward balancing (6cm)* movement as desired. Considering the mid-test results, it is seen that the child can do the movement two (2) times as desired. Considering the post-test results, it is seen that the child can do the same movement three (3) times as desired.

Figure 8: Stepping sideways (20 seconds)



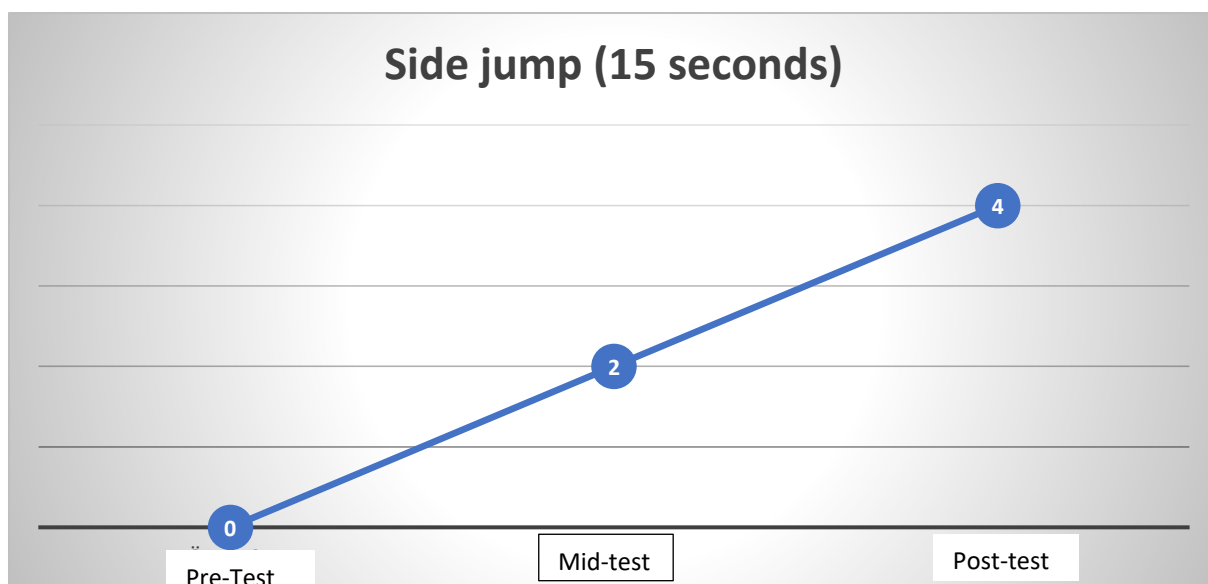
Considering the pre-test results in Figure 8, it is seen that the child could not perform *the sideways stepping (20 seconds)* movement in accordance with the rules. Considering the mid-test results, it is seen that the child can do the movement three (3) times as desired. Considering the post-test results, it is seen that the child can do the same movement five (5) times as desired.

Figure 9A: Right and left one-foot jump



Considering the pre-test and mid-test results in Figure 9A, it is seen that the child could not perform *the right and left foot jumping* movements in accordance with the rules. Considering the post-test results, it is seen that the child can perform the same movement five (5) times with the right foot and four (4) times with the left foot in accordance with the rules.

Figure 9B: Side jump (15 seconds)



Considering the pre-test results in Figure 9B, it is seen that the child could not perform *the side-jump (15 seconds)* movement skills. Considering the mid-test results, it is seen that the child can perform the movement two (2) times as desired. Considering the post-test results, it is seen that the child can do the same movement four (4) times as desired.

Discussion and Conclusion

Backward balancing (3cm) in Figure 1A, *backward balancing (4.5cm)* in Figure 1B, and *backward balancing (6cm)* in Figure 1C, it is seen that the child could not perform these movements before starting the education. Considering the mid-test results six weeks after the studies started, it is seen that the child can do these movements once. Considering the post-test results taken in the twelfth week when the practical training is over, it is seen that the child can do the same movements twice. It can be said that adapted brain-based movement trainings applied in line with the results obtained contribute to the child's ability to perform movements independently as desired. At the same time, it can be said that the adapted activities are suitable for the child's development, providing the child with adequate support in the studies and giving the time he/she needs are also effective in the child's ability to do these movements.

According to the results in Figure 2, it is seen that the child could not perform the *step sideways (20 seconds)* movement in accordance with the rules, and that the child was able to perform the movement three times as desired, considering the mid-test results six weeks after the start of the adapted brain-based movement training studies. Considering the post-test results taken in the twelfth week when the practical training is over, it is seen that the child can do the same movement five times as desired. According to the results obtained after the studies, it can be said they are effective in the development of the child's motor skills that the adapted brain-based movement trainings that applied are suitable for the development of the child, giving the time he/she needs and providing the child with adequate support in the studies.

Considering the pre-test and mid-test results in Figure 3A, the child could not perform *the right and left foot jumping* in accordance with the rules. Considering the post-test results obtained in the twelfth week when the adapted brain-based movement training studies were completed, it is seen that the child can perform the same movement five times with the right foot and three times with the left foot in accordance with the rules. According to the results obtained after the studies, it can be said they are effective in the development of the child's motor skills that the adapted brain-based movement trainings that applied are suitable for the development of the child, giving the time he/she needs and providing the child with adequate

support in the studies. At the same time, it is seen that children with special needs can use the dominant side of their body better, as in children with normal development.

Considering the pre-test results in Figure 3B, the child could not perform the *side-jump (15 seconds)* movement skill, considering the mid-test results, in which adapted brain-based movement education studies continue, it is seen that the child can perform the movement as desired once. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement five times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

It is mentioned in studies that brain-based activities have effects on motor skills and different physiological parameters (Yarim, et al., 2019). Peker and Taşkıran (2016), in their study named the effects of brain-based activities on coordinative abilities, reported that the results of the experimental group were found to be significantly higher than the control group in the tests they divided into balance, rhythm and orientation ability. In the study conducted by Mugan (2019), it was determined that the twelve-week brain-based trainings had significant differences in the movement speed of the application group and also had a positive contribution to the balance parameters. Vural (2016), in his study on young male basketball players, reported that brain-based activities provide improvement in children's attention and reaction time.

Considering the initial level and pre-test results in Figure 4A, the child could not perform the *backward balancing (3cm)* movement as desired, considering the mid-test results in which adapted brain-based movement education studies continue, it is seen that the child can perform the movement as desired once. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement twice as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the initial level and pre-test results in Figure 4B, the child could not perform the *backward balancing (4.5 cm)* movement as desired, considering the mid-test results, in which adapted brain-based movement education studies continue, it is seen that the child can do the movement twice as desired. Considering the post-test results taken in the twelfth week of her studies, it is seen that the child can do the same movement three times as desired. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement three times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the initial level and pre-test results in Figure 4C, *backward balancing (6cm)*, the child cannot perform the movement as desired, considering the mid-test results, in which adapted brain-based movement education studies continue, it is seen that the child can do the movement twice as desired. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement three times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills. In addition, it can be said that the increase in the width of the balance surface is also effective in the child's walking movement more. It is seen that the adaptation of the application materials according to the developmental levels of the children is effective in the development of the motor skills of the children.

Considering the pre-test results in Figure 5, the child could not perform the *sideways step (20 seconds)* movement in accordance with the rules, considering the mid-test results in which adapted brain-based movement education studies continue, it is seen that the child can do the movement as desired three times. Considering the post-test results taken in the twelfth week

of his studies, it is seen that the child can do the same movement five times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the pre-test and mid-test results in Figure 6A, the child could not perform *the right and left foot jumps* and movements in accordance with the rules, considering the post-test results taken in the twelfth week when the adapted brain-based movement training studies were completed, it is seen that the child can perform the same movement five times with the right foot and three times with the left foot in accordance with the rules. According to the results obtained after the study, it is seen that the child can jump more with the dominant foot. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the pre-test results in Figure 6B, the child could not perform the side-jump (15 seconds) movement skill, It is seen that he/she can do it once adapted brain-based movement training studies continue. Considering the post-test results taken in the twelfth week of his studies, it is seen that the child can do the same movement three times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

It has been reported that brain-based exercises performed by Çoban (2019) cause changes in individuals' skills such as balance, focus, attention. As a result of the research conducted by Kulak et al. (2011) they reported that the balance, flexibility and speed skills of brain-based activities improved in favor of the experimental group. In Stewart's (2006) study with athletes who are new to ice skating, it was stated that the brain-based training method is more beneficial than classical training.

Considering the initial level and pre-test results in Figure 7A, the child could not perform the *backward balancing (3cm)* movement as desired, considering the mid-test results, in which adapted brain-based movement education studies continue, it is seen that the child can perform the movement as desired once. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement twice as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the initial level and pre-test results in Figure 7B, the child could not perform the *backward balancing (4.5 cm)* movement as desired, considering the mid-test results in which adapted brain-based movement education studies continue, it is seen that the child can do the movement twice as desired. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement three times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the initial level and pre-test results in Figure 7C, the child could not perform the *backward balancing (4.5 cm)* movement as desired, considering the mid-test results in which adapted brain-based movement education studies continue, it is seen that the child can do the movement twice as desired. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement three times as desired. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the pre-test results in Figure 8, the child could not perform the *sideways step (20 seconds)* movement in accordance with the rules, considering the mid-test results in which the adapted brain-based movement training studies continue, it is seen that the child can do the movement three times as desired. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement five times as desired.

According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the pre-test and mid-test results in Figure 9A, the child could not perform the *right and left foot jumps* and movements in accordance with the rules, Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement five times with the right foot and four times with the left foot in accordance with the rules. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Considering the pre-test results in Figure 9B, the child could not perform the *side-jump (15 seconds)* movement skill, considering the mid-test results in which adapted brain-based movement education studies continue, it is seen that the child can do the movement twice as desired. Considering the post-test results taken in the twelfth week of his/her studies, it is seen that the child can do the same movement four times. According to the results obtained after the studies, it can be said that the adapted brain-based movement trainings are effective in the development of the child's motor skills.

Smith et al. (2007) reported that brain-based exercises are effective in the development of motor skills in a study on female gymnasts. In the study of Olsson et al. (2008) on high jump athletes, they found a significant difference in favor of the experimental group in skills such as jump height and jump angle of the athletes in the experimental group. In the study conducted by Tenry et al. (1998), it was concluded that brain-based training is beneficial in the preparatory phase of water sports beginners.

While the children could not perform the desired behaviors independently before starting the training, it was observed that they were able to perform the desired movements independently when the children were given the opportunity to repeat the activities prepared and applied with intermittent repetition in accordance with the developmental levels of the children. At the same time, considering the age of the children, it was concluded that they could move more easily on the material consisting of large surface floors and the learning action was easier. It was concluded that children learn simple movements faster than complex movements at their age. It has been observed that children can use these aspects better because their right side is dominant. It was concluded that with the dominant side of this situation, they learned a move faster and could repeat it more. As a result of the interviews with the families of the children, it was learned that the children were calmer and more harmonious in their home life. It has been concluded that the adapted brain-based movement training program is effective in the development of psychomotor skills such as attention, balance and coordination in children with mild autism.

Recommendations

In today's world, where the importance of doing brain-based activities is increasing, different studies can be carried out on how to increase the performance of sports skills, as well as being effective in the motor skill development of individuals especially in childhood.

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