"The Impact of Brain Gym Program on Brain Function and Enhancing Kata Performance in Traditional Karate Players"

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Introduction and Research Problem:

The continuous technological advancements in neurocognitive measurement and assessment methods in the field of neuropsychology have provided numerous insights and scientific evidence elucidating the qualitative and specialized functions of different regions, centers, and lobes of the brain. Scientific evidence has also affirmed that each hemisphere of the brain possesses a cognitive-perceptual pattern that distinguishes it from the other in terms of programming system, type of information, and specialized cognitive functions.

However, it is crucial to recognize that one cannot separate the integrative and coordinated functions of both hemispheres. Any cognitive activity cannot achieve the highest level of efficiency without functional integration and coordination between all parts of the brain (Tarek Mohamed Badr El-Din, 2016).

The source of movement is the nervous system, which sends neural signals to the muscles, causing them to act according to the required movement. Each movement is controlled by both large and small muscles, and it is associated with both count and time, meaning that each movement has its own rhythm" (Mona El-Badry, 2008).

Thus, the sensitivity of the motor, visual, and auditory systems may serve as evolutionary functions to benefit from specific and unique aspects of information processing, enhancing control and organizing motor behavior (Thaut, 1999).

There is no separation between the mind and the body, and cognitive performance depends on the human ability to engage in physical activity. Mental exercise is crucial for human activity, health, and longevity. There is a distinction between mental exercises that increase focus and information retrieval and other mind games designed for entertainment and mental stimulation through concentration, incorporating principles of gain and loss, such as chess (Weiss RP, 2000).

"Brain Gym" is part of an educational movement program that means "learning through movement." It is a program based on advanced movements that work to improve neural communication throughout the mind and body, helping us reach our highest learning potential and develop life skills. The program is highly effective and enjoyed by those who use it (Stephenson J, 2009).

Brain Gym has been utilized in more than 80 countries in education, business, sports, and performing arts with profound and lasting results (Brain Gym International® [BGI], 2003).

Brain Gym is an educational movement system developed by Dr. Paul Dennison and Gail E. Dennison to accelerate the learning process through accelerated physical exercise. After Dennison exercises and physical activities to balance the brain and create new neural pathways to facilitate learning body coordination more quickly, it eventually leads to spiritual coordination. The philosophy of human movement and the educational movement science, and how body movements are learned, are included in Brain Gym. It consists of 26 specific movements designed to activate the brain to function better, assisting the nervous and sensory-motor systems in synchronizing according to the timetable most efficiently. Once the brain integrates with the movements, learning becomes a complete, faster, and easier cognitive activity (Spaulding LS, Mostert MP, Beam AP, 2010).

Brain Gym is a brain-based program that relies on a specific system of bodily movements aimed at preparing all sections of the brain for the learning process, emphasizing "learning with the whole brain, both the right and left hemispheres." It includes 26 easy and enjoyable movement exercises that work to enhance communication between the body and the mind.

This program leads to rapid and noticeable improvement in various aspects, including concentration, memory, reading, writing, organization, listening, motor coordination, and more. Additionally, it naturally develops neural pathways in the brain by incorporating movement.

As studies and experiments have proven, Brain Gym is suitable for application across all age groups, including adults and the elderly. The program focuses on three axes:

1. Laterality Axis (Laterality): Describes the relationship between the two hemispheres of the brain and is fundamental for reading, writing, conversation, as well as programming full-body movement, motor skills, and simultaneous thinking.
2. Focus Axis (Focus): Describes the relationship between the frontal and posterior regions of the brain and influences understanding, comprehension, and the integration of new information with existing experiences.
3. Centering Axis (Centering): Concerned with the relationship between the upper and lower parts of the brain, centering allows for balance between emotions and logical thoughts, helping with calmness and organization.

The exercises and the three-dimensional repatterning involve:

- Midline Movement Exercises
- Crossing the Midline Exercises
- Lengthening Muscle Exercises
- Energy Exercises
- Deepening Attitudes Exercises
- Three-Dimensional Repatterning

(Cecilia Freeman. Aim Child 1998), (Cecilia Freeman & Joyce B. Sherwood. 2000), (WWW.braingym.org), (Journal of Science Mail) 2005.

The theoretical foundation upon which the Brain Gym operates is relatively simplified and can be delineated into three dimensions: Horizontal, Focus, and Centering. According to literature, Brain Gym is grounded in the following theoretical perspectives:

1. Horizontal Dimension: This refers to the coordination between the right and left hemispheres of the brain. It is considered essential for reading, writing, listening, speaking, as well as the ability to move and think simultaneously (Grabe M. 2014).
2. Focus Dimension: This pertains to the ability to coordinate information between the frontal and posterior parts of the brain. It is associated with comprehension, attention, and activity.
3. Centering Dimension: This involves the coordination between the upper and lower halves of the brain, which is deemed necessary for achieving balance between rational thinking and emotion (Sigman, M., Peña, M., Goldin, A. P., & Ribeiro, S. 2014).

The Brain Gym technique encompasses four simple movements used to stimulate an individual's perception, increase attention, synchronize and regulate organizational skills, and enhance theoretical status alongside building relationships, self-respect, and confidence. These four movements are part of a larger, detailed program.

The first activity involves drinking water. The positive activity is referred to as "Brain Buttons," aiming to wake up the brain. The technique involves placing one hand on the navel or directly below it and the other hand on the notch of the throat. Then, friction is applied in this area. In traditional Chinese medicine, this method is believed to help awaken the brain (Constantinidis, C., & Klingberg, T. 2016).

The third activity is called "Cross Crawl," and it primarily involves connecting any part of the right arm with any part of the left leg, and vice versa. There are various ways to do this, such as using Tai Chi style where everything is flowing. Crossing the midline is crucial because it stimulates the spine by engaging the reflexes of the cross-crawl. When the spine is stimulated, it leads to brain stimulation as well (Moustafa, A., & Ghani, M. Z. 2016).

The fourth activity is called "Hook-ups." In this activity, the arms are placed in front of the body, wrists crossed over each other, thumbs facing downwards, and the hands interlocked, pulling them inward. This position is highly calming and effective, as everything aligns with the midline, and the second part involves crossing the ankles.

Brain Gym is a series of simple movements performed to stimulate optimal brain function through empowerment and athletic development. The movements of Brain Gym integrate with physical fitness, creating a fusion of physical exercises and brain balance management. Brain Gym is dynamically charged and aims to assist students.

Another perspective views Brain Gym as a series of simple and enjoyable movements used by students in Educational Kinesiology (Edu-K) to enhance their learning abilities by engaging the entire brain. These movements make all types of lessons easier and are particularly beneficial for academic and athletic capabilities. Edu-K is a system that enables learning without age limitations, utilizing motor activities to extract the full potential of individuals and harness the quadrilateral use of the human brain (Taufik Rihatno 2017).

Hermann "Ruhaak, A. E., & Cook, B. G. (2016)" proposed a symbolic model for the human brain, called the "Quadrune Brain Model." This theory is also referred to as the Compass of Thinking or Herman's Thinking Scale. The model illustrates that the brain is composed of four interconnected regions, symbolically dividing it into quadrants. Each region is specialized in a specific way of mental functioning, and these areas work together to form the entire brain. Moreover, one or more regions may dominate or control human behavior, depending on the following figure:

Figure (1)

Hermann divided the cognitive control patterns into four categories:

1. The upper left part of the brain, "Analytical Upper Left Region" (A).
2. The lower left part of the brain, "Executive-Regulatory Left Region" (B).
3. The lower right part of the brain, "Humanitarian-Emotional Right Region" (C).
4. The upper right part of the brain, "Creative-Free Right Region" (D).

Based on the division of thinking styles and cognitive dominance proposed by Hermann in the Quadrune Theory, there are six cognitive dominance profiles:

1. Individual/Basic Dominance Thinking Profile
2. Dual Dominance Thinking Profile
3. Upper or Lower Dominance Thinking Profile
4. Diagonal Dual Dominance Thinking Profile
5. Triple Dominance Thinking Profile
6. Quadruple Dominance Thinking Profile

The survey conducted by Hermann on 500,000 individuals revealed that each person has a primary cognitive dominance profile, where one of the four quadrants (A, B, C, or D) dominates their thinking.

The results were as follows:

- 60% think using only two quadrants.
- 30% think using three quadrants.
- 7% think using only one quadrant.
- 3% think equally using all four quadrants.

Additionally, Tarek Badr El-Din (2016) suggests that identifying cognitive dominance patterns in athletes contributes to directing them toward sports activities that align with their predominant cognitive dominance. This, in turn, ensures excellence, proficiency, and sustained engagement in sports for extended periods. Coaches can tailor training activities and strategies to support and develop functions associated with the dominant brain hemisphere while also activating functions related to the non-dominant side. This approach leads to a balanced and integrated development of both brain hemispheres, allowing learners to acquire abilities and skills that match their unique cognitive dominance pattern.

Moreover, there is significant importance in utilizing both brain hemispheres (balanced control) in the learning and teaching processes, as performance efficiency is associated with the left hemisphere (high-level skill performance), while the right hemisphere is crucial for achieving performance goals and employing skills optimally in competitive situations.

Hermann's theory emphasizes the function and importance of mental or cognitive fingerprinting. Understanding one's cognitive fingerprint, whether it falls into category A, B, C, or D, allows individuals to choose a profession that aligns with their thinking style. This concept suggests that individuals may lean towards and prefer certain categories, influencing their career choices accordingly (Tarek Mohamed Badr El-Din, 2016).

Furthermore, martial arts activities, particularly Taekwondo, have been observed to enhance functional connectivity from the cerebellum to the right inferior frontal gyrus in children. This improved functional connectivity is associated with the need for executing each action at maximum speed for effectiveness and sustainability (K.D. Lakes et al., 2013; O. Volodchenko et al., 2017).

The term "kata" in martial arts refers to a connected series of movements that involve a mix of defensive and offensive techniques following an internationally recognized pattern. These techniques include blocking, striking, and kicking in various directions and at different speeds, directed towards the three levels of the attacker's body or a group of simulated attackers. The execution of these techniques is coupled with adopting various stable and dynamic balance positions (Ahmed Mahmoud Ibrahim, Atef Mohamed Abozahra, 2005).

The kata is considered the essence of real karate, one of the pillars of the sport and the correct and influential way to understand the different styles in karate. Despite this, coaches' focus during training is usually on skill performance only. Therefore, the idea of training in a step-by-step method in place was innovated by Dr. Ibrahim Al-Bakr, the head of the Asian Union and a member of the International Karate Federation in 2020. This method aimed to overcome the challenges faced by players during training at home due to the global COVID-19 pandemic.

Consequently, a method for training via Zoom programs was developed. Given the limited spaces at home, training and daily routines for players began with a single step in the same direction as the four kata and up and down. This caught the attention of the researcher, noting the relative improvement in the players' performance in some kata skills.

Therefore, the researcher is trying to find a method to increase neural connections in the brain through kata training in a step-by-step method in all directions. This aligns with the scientific basis of Brain Gym, forcing the brain to use all four sections to achieve the highest mastery in performance. The scientific theory of Brain Gym fundamentally relies on working on the main axis, horizontally, upward, and downward.

The researcher found that this can be achieved through performing various kata, including basic kata and performance criteria for traditional karate players in all competitions. These kata consist of 50 skills, involving movements to the right and left, or vice versa, with different stabilities. They work on the main axis, horizontally, upward, and downward, with increased difficulty in performance when performing these kata in all directions with just a single step while maintaining the kata's form. This increases neural entanglements in the brain, enhances neural connections, and leads to improved performance.

Research Objective:

The research aims to understand the "Effect of the Brain Gym program on brain print and improvement in kata performance for traditional karate players."

Research Hypotheses:

1. There are statistically significant differences between the pre-test and post-test averages in physical skill performance in favor of the post-test measurement.
2. There are statistically significant differences between the pre-test and post-test averages in the four sections of cognitive control in favor of the post-test measurement.
3. There are statistically significant differences between the pre-test and post-test averages in kata performance in favor of the post-test measurement.
4. There are improvement ratios in the brain print in favor of the post-test measurement.

Research Methodology:

The researcher employed the experimental method using a single group with pre-test and post-test measurement approach, aligning with the nature of the study.

Research Sample:

The research sample was selected randomly from traditional karate players at the Hero Sport

Academy in Shubra El Kheima, Qalyubia Governorate, who hold brown and black belts, specifically for the age group under 15 years. The total number of participants was 12 players, in addition to 8 players for the exploratory and standardization study outside the primary research sample. Before implementing the program, and to control the variables that may affect the accuracy of the research results, the researcher ensured the homogeneity of the research sample.

The following table illustrates the homogeneity of the research sample in variables that may have an impact on the proposed rhythmic program application. These variables include height, weight, age, and training age, which were verified through the player's data form.

Table (1)
Mean, Median, Standard Deviation, and Skewness Coefficient for the Variables of the Research Sample (n=20)

No.	Variables	Measurement Unit	Mean	Median	Standard Deviation	Skewness Coefficient
1	Height	Cm	166.59	165.00	4.62	1.032
2	Weight	Kg	46.52	65.00	5.92	0.770
3	Age	Year	14.55	14.00	0.55	0.117
4	Training age for karate	Year	4.62	4.50	0.75	0.480
5	Training age for traditional karate	Year	2.61	2.50	0.64	0.515

The table (1) indicates that the skewness coefficient ranges between (1.032 to 0.117), i.e., confined within (± 3), indicating that the research sample is homogeneous in these variables.

Table (2)
Mean, Standard Deviation, Median, and Skewness Coefficient for the Investigated Physical Skill Capability (n=20)

No.	Tests	Skills	Measurement Unit	Direction	Mean	Standard Deviation	Median	Skewness Coefficient
1	Muscular strength for legs	Mawashi Geri + Mai Geri	15 Sec.	Right	1.65	0.21	1.55	1.428
				Left	1.44	0.12	1.40	0.571
2	Muscular strength for arms	Kizami Zuki + Gyaku Zuki	10 sec.	Right	2.41	0.32	2.20	1.968
				Left	1.69	0.88	1.50	0.647
3	Agility	Kiyago Zuki + Mawashi Geri + Mai Geri	10 Sec.		0.85	0.15	0.80	0.999
4	Compatibility	Ao Uchi + Age Ushiro + Mai + Kiage	20 Sec.	Right	1.65	0.33	1.60	0.454
				Left	1.22	0.41	1.20	0.146
5	Arm speed endurance	Kizami Zuki + Gyaku Zuki	20 Sec.	Right	1.52	0.32	1.50	0.187
				Left	1.63	0.35	1.60	0.257
6	leg speed endurance	Mawashi Geri + Mai Geri	30 Sec.	Right	3.52	0.44	3.50	0.136
				Left	4.32	0.16	4.30	0.375
7	Arm power endurance	Kizami Zuki + Gyaku Zuki	30 Sec.	Right	3.61	0.32	3.50	1.031
				Left	4.52	0.19	4.50	0.315

Follow Table (2)
Mean, Standard Deviation, Median, and Skewness Coefficient for the Investigated Physical Skill Capability (n=20)

No.	Tests	Skills	Measurement Unit	Direction	Mean	Standard Deviation	Median	Skewness Coefficient
8	Muscular power endurance for the legs	Mawashi Geri + Mai Geri	30 Sec.	Right	5.62	0.31	5.50	1.161
				Left	7.32	0.97	7.00	0.989
9	Muscular power endurance for the arms and legs	Kizami Zuki + Kizami Mawashi	30 Sec.	Right	8.32	0.91	8.00	1.054
				Left	5.85	0.64	5.50	1.640
10	Agility endurance	Kiyago Zuki + Mawashi Geri + Mai Geri	35 Sec.		1.95	0.75	1.90	0.199
11	Performance endurance for the legs	Mawashi Geri + Mai Geri	40 Sec.	Right	7.62	0.49	7.50	0.480
				Left	5.25	0.99	5.00	0.757
12	Performance endurance for the arms	Kizami Zuki + Gyaku Zuki	40 Sec.	Right	11.25	0.67	11.00	1.119
				Left	10.22	0.85	10.00	0.776

The table (2) indicates that the skewness coefficient ranges between (0.0193 to 0.709), i.e., confined within (± 3), suggesting that the research sample is homogeneous in these variables.

Table (3)
Mean, standard deviation, median, and skewness coefficient in the variables of the Herman Scale questionnaire (n = 20)

No.	Herman Scale questionnaire	Measurement Unit	Mean	Standard Deviation	Median	skewness coefficient
1	Direction (A)	Degree	8.62	0.97	8.50	0.371
2	Direction (B)	Degree	9.11	0.84	9.00	0.392
3	Direction (C)	Degree	7.19	0.69	7.00	0.826
4	Direction (D)	Degree	7.51	0.82	7.50	0.0365

It is evident from Table (3) that the skewness coefficient ranges between (0.365 to 0.392), indicating a range within (±3). This implies that the research sample is homogeneous in these variables.

Table (4)
Mean, standard deviation, median, and skewness coefficient in the Kata Evaluation Form variables (n = 20)

No.	Variables	Measurement Unit	Mean	Standard Deviation	Median	skewness coefficient
Skill Performance Level in Kata.		Degree	20.19	1.98	20.00	0.287

It is evident from Table (4) that the skewness coefficient is within the range of (0.287), indicating that it falls within (±3). This suggests that the research sample is homogeneous in these variables.

Data Collection Tools:

1- Measuring Tools:

- A stadiometer for measuring height in centimeters.
-Medical scale for weight measurement in kilograms, calibrated with other scales.
- Measuring tape.
- Stopwatch.
- Two indicators.
- Video camera.

2- Questionnaires:

The researcher designed a questionnaire to achieve the research objectives as follows:

a. Conditions for selecting experts and their names (attached as Annex 1).
b. Player information form (attached as Annex 2).
c. Kata performance form (attached as Annex 4).
d. Survey form for expert opinions on the proposed program (attached as Annex 5).

3. Scales:
a. Herman's Brain Dominance Scale.
4. Tests.

Survey Study:
The researcher conducted a survey study on a sample of players from within the research community and outside the primary sample, consisting of (8) players.
The objectives of the study were:
- To determine the scientific parameters (validity and reliability) for the tests used in the research.
- To verify the suitability of using the tools and train assistants on the utilized tests.
- To confirm the absence of issues during the application of training sessions on the players.

Scientific Parameters for the Tests **Under Study:**

Validity:

The researcher selected (8) players from within and outside the original sample to investigate the validity of the pairwise comparison between the highest and lowest quartile.

Table (5)
Validity of Pairwise Comparison for Skill Performance and Inter-Attack Time (N1=N2=2)

No.	Variables	Measurement Unit	Direction	Highest Quartile		Lowest Quartile		Value (t)	Significance Level
				Mean	Standard Deviation	Mean	Standard Deviation		
1	Mawashi Geri + Mai Geri	15 Sec.	Right	1.65	0.52	1.11	0.45	3.98	Stat. Func.
			Left	1.48	0.11	1.32	0.62	4.25	Stat. Func.
2	Kizami Zuki + Gyaku Zuki	10 sec.	Right	2.65	0.032	2.02	0.11	3.66	Stat. Func.
			Left	1.64	0.61	1.44	0.32	3.42	Stat. Func.

Follow Table (5)
Validity of Pairwise Comparison for Skill Performance and Inter-Attack Time (N1=N2=2)

No.	Variables	Measurement Unit	Direction	Highest Quartile		Lowest Quartile		Value (t)	Significance Level
				Mean	Standard Deviation	Mean	Standard Deviation		
3	Kiyago Zuki + Mawashi Geri + Mai Geri	10 Sec.		0.97	0.18	0.54	0.14	4.32	Stat. Func.
4	Ao Uchi + Age Ushiro + Mai + Kiage	20 Sec.	Right	1.91	0.32	1.42	0.21	4.29	Stat. Func.
			Left	1.29	0.51	1.10	0.28	2.97	Stat. Func.
5	Kizami Zuki + Gyaku Zuki	20 Sec.	Right	1.55	0.37	1.24	0.33	3.62	Stat. Func.
			Left	1.69	0.15	1.36	0.21	4.36	Stat. Func.
6	Mawashi Geri + Mai Geri	30 Sec.	Right	3.64	0.33	3.22	0.18	3.87	Stat. Func.
			Left	4.55	0.41	3.91	0.62	4.33	Stat. Func.
7	Kizami Zuki + Gyaku Zuki	30 Sec.	Right	3.74	0.36	3.12	0.25	4.28	Stat. Func.
			Left	4.97	0.28	4.02	0.11	3.62	Stat. Func.
8	Mawashi Geri + Mai Geri	30 Sec.	Right	5.94	0.31	5.06	0.30	4.31	Stat. Func.
			Left	7.81	0.15	6.35	0.21	3.39	Stat. Func.
9	Kizami Zuki + Kizami Mawashi	30 Sec.	Right	8.85	0.37	7.32	0.17	3.45	Stat. Func.
			Left	5.91	0.15	4.80	0.21	4.21	Stat. Func.
10	Kiyago Zuki + Mawashi Geri + Mai Geri	35 Sec.		1.98	0.32	1.36	0.11	3.66	Stat. Func.
11	Mawashi Geri + Mai Geri	40 Sec.	Right	7.88	0.22	7.02	0.17	4.21	Stat. Func.
			Left	5.54	0.18	4.44	0.31	3.19	Stat. Func.
12	Kizami Zuki + Gyaku Zuki	40 Sec.	Right	11.65	0.31	8.67	0.22	3.54	Stat. Func.
			Left	10.95	0.18	7.63	0.29	3.15	Stat. Func.

The critical (t) value at the 0.05 level = 1.182

It is evident from Table (5) that there are statistically significant differences between the highest and lowest quartile in the tests under study, in favor of the highest quartile. This indicates the validity of these tests in distinguishing between the different groups.

Table (6)

Validity of the Comparative Side Form Herman Scale (n1=n2=2)

No.	Variables	Measurement Unit	Highest Quartile		Lowest Quartile		Value (t)	Significance Level
			Mean	Standard Deviation	Mean	Standard Deviation		
1	Direction (A)	Degree	9.10	0.62	7.21	0.25	4.36	Stat. Func.
2	Direction (B)	Degree	9.68	0.52	8.05	0.34	4.32	Stat. Func.
3	Direction (C)	Degree	7.95	0.28	6.54	0.15	3.28	Stat. Func.
4	Direction (D)	Degree	8.10	0.32	6.94	0.32	4.32	Stat. Func.

The critical (t) value at the 0.05 significance level = 1.182

It is evident from Table (6) that there are statistically significant differences between the upper quartile and the lower quartile in the tests under study, in favor of the upper quartile. This indicates the validity of these tests in distinguishing between the different groups.

Table (7)

Validity of the paired comparison in the skill performance level of Kata (n1 = n2 = 2)

No.	Variables	Measurement Unit	Highest Quartile		Lowest Quartile		Value (t)	Significance Level
			Mean	Standard Deviation	Mean	Standard Deviation		
1	Skill performance level of Kata	Degree	23.62	0.69	18.36	0.62	8.62	Stat. Func.

The critical (t) value at a significant level of 0.05 = 1.182.

It is evident from Table (7) that there are statistically significant differences between the upper quartile and the lower quartile in the tests under consideration, in favor of the upper quartile. This indicates the validity of these tests in distinguishing between the different groups.

Secondly: Reliability

To calculate the reliability of the tests, the researcher employed the Test-Retest method. The researcher applied the tests to a sample from the research community and another sample not included in the original research sample, consisting of (8) players.

Then, she reapplied the tests to the same sample and calculated the correlation coefficient between the first and second applications to determine the reliability of these tests. Table (8) illustrates the correlation coefficient between the two applications.

Table (8)
Reliability Coefficient of Physical Skill Variables Under Study (n = 8)

No.	Variables	Measurement Unit	Direction	First Application		Second Application		Correlation coefficient	Significance Level
				Mean	Standard Deviation	Mean	Standard Deviation		
1	Mawashi Geri + Mai Geri	15 Sec.	Right	1.59	0.32	1.68	0.24	0.925	Stat. Func.
			Left	1.44	0.14	1.71	0.52	0.987	Stat. Func.
2	Kizami Zuki + Gyaku Zuki	10 sec.	Right	2.29	0.11	2.61	0.12	0.965	Stat. Func.
			Left	1.61	0.32	1.75	0.26	0.978	Stat. Func.
3	Kiyago Zuki + Mawashi Geri + Mai Geri	10 Sec.		0.84	0.14	0.91	0.32	0.925	Stat. Func.
4	Ao Uchi + Age Ushiro + Mai + Kiage	20 Sec.	Right	1.64	0.22	1.78	0.28	0.945	Stat. Func.
			Left	1.31	0.32	1.55	0.19	0.987	Stat. Func.
5	Kizami Zuki + Gyaku Zuki	20 Sec.	Right	1.59	0.18	1.67	0.20	0.965	Stat. Func.
			Left	1.69	0.21	1.81	0.34	0.925	Stat. Func.
6	Mawashi Geri + Mai Geri	30 Sec.	Right	3.81	0.25	3.97	0.6	0.945	Stat. Func.
			Left	4.62	0.32	4.91	0.55	0.947	Stat. Func.
7	Kizami Zuki + Gyaku Zuki	30 Sec.	Right	3.87	0.11	4.10	0.32	0.965	Stat. Func.
			Left	4.67	0.17	4.91	0.17	0.922	Stat. Func.
8	Mawashi Geri + Mai Geri	30 Sec.	Right	5.91	0.30	6.05	0.31	0.947	Stat. Func.
			Left	7.55	0.32	7.88	0.22	0.925	Stat. Func.
9	Kizami Zuki + Kizami Mawashi	30 Sec.	Right	8.54	0.04	8.91	0.18	0.964	Stat. Func.
			Left	5.59	0.32	5.64	0.31	0.945	Stat. Func.
10	Kiyago Zuki + Mawashi Geri + Mai Geri	35 Sec.		1.94	0.15	2.10	0.011	0.925	Stat. Func.
11	Mawashi Geri + Mai Geri	40 Sec.	Right	7.91	0.14	8.10	0.28	0.978	Stat. Func.
			Left	5.67	0.28	5.94	0.52	0.925	Stat. Func.
12	Kizami Zuki + Gyaku Zuki	40 Sec.	Right	11.94	0.16	12.10	0.61	0.990	Stat. Func.
			Left	10.97	0.31	11.32	0.19	0.947	Stat. Func.

The critical (r) value at a significant level of 0.05 is 0.62.

Table (8) indicates that the correlation coefficients between the first and second applications of the tests under study ranged from 0.900 to 0.985, which are statistically significant correlation coefficients, indicating an acceptable level of reliability for the tests.

Table (9)
Reliability Coefficients for the Variables of Harman Scale (n=8)

No.	Variables	Measurement Unit	First Application		Second Application		Correlation coefficient	Significance Level
			Mean	Standard Deviation	Mean	Standard Deviation		
1	Direction (A)	Degree	8.98	0.62	9.10	0.71	0.965	Stat. Func.
2	Direction (B)	Degree	9.51	0.18	9.68	0.62	0.988	Stat. Func.
3	Direction (C)	Degree	7.65	0.32	8.26	0.58	0.964	Stat. Func.
4	Direction (D)	Degree	8.10	0.15	9.00	0.32	0.925	Stat. Func.

The critical value (r) at a significance level of 0.05 is 0.62.

It is evident from table (9) that the correlation coefficients between the first and second applications for the tests under study ranged between (0.925 to 0.988). These correlation coefficients are statistically significant, indicating that the tests have an acceptable level of reliability.

Table (10)
Reliability coefficient for skill performance variables in kata (n=8)

No.	Variables	Measurement Unit	First Application		Second Application		Correlation coefficient	Significance Level
			Mean	Standard Deviation	Mean	Standard Deviation		
1	Skill Performance Level in Kata	Degree	21.62	0.52	22.98	0.51	0.958	Stat. Func.

The value (r) at the table level at 0.05 = 0.62.

It indicates from Table (10) that the correlation coefficients between the first and second applications for the tests under study ranged between (0.958), which are statistically significant correlation coefficients, indicating that the tests have an acceptable degree of reliability.

Steps for Building the Program:

The proposed program:

- The impact of the Brain Gym program on brain print and improving the performance of traditional karate players.

Steps for preparing the rhythmic training program:

- Conduct a survey of relevant research and studies on the research variables.
- Interview experts and benefit from their diverse experiences in designing

training programs specific to this age group.

General Principles for Developing the **Training Program:**

- The program is built on enhancing performance in kata, working in different directions, and both the horizontal and vertical directions, all from a single step.
- The program is applied during the preparation period for competitions according to the training plan, which spans 8 weeks.
- The training sessions are conducted three times a week during the competition preparation period.

Steps for Implementing the Research:

First: Pre-measurements:

The pre-measurements were conducted for the traditional karate players participating in kata competitions in the national championships in all variables as follows:

A. Physical-motor measurements and the application of the Herman scale for cognitive control were conducted on Friday, January 7, 2022.

B. The assessment of kata performance was measured by organizing an internal championship. This tournament was a semi-league among the players, and the matches were recorded through video footage with the presence of 4 judges, following the kata judging form (attached as Form 4) on Saturday, January 8, 2022.

Second: Program Implementation:

The proposed Brain Gym program was implemented starting from Monday, January 10, until Friday, February 4, 2022, following the research procedures. The training units were conducted at 7:00 PM on Mondays, Wednesdays, and Fridays each week, as indicated in figure (18).

Third: Post-measurements:

The Post-measurements were conducted as follows:

A- Physical skill measurements and the application of the Herman Scale for cognitive control were performed on Monday, February 14, 2022.

B- Kata performance level measurement was conducted through an internal tournament, which was a half-league competition among players. The matches were recorded via video with the presence of 4 judges, following the Kata judging form, on Friday, February 18, 2022, as attached (4).

The statistical methods used to extract results include the following:

1. Mean (Arithmetic Mean)
2. Standard Deviation
3. Coefficient of Variation
4. t-tests for correlated samples
5. Cronbach's Alpha for reliability calculation
6. Improvement Ratio

Presentation and Discussion of Results:

Table (11)
Significance of differences between pre-measurements and post-measurements in the level of physical skill variables (n=12)

Tests	Skills	Measurement Unit	Direction	Pre-measurement		Post-measurement		Differences between the averages	Improvement percentage	Value (t)	Significance Level
				Mean	Standard Deviation	Mean	Standard Deviation				
Muscular strength for legs	Mawashi Geri + Mai Geri	15 Sec.	Right	1.65	0.21	4.69	0.51	3.04	64.81%	5.21	Stat. Func.
			Left	1.44	0.12	3.31	0.32	1.87	56.49%	3.69	Stat. Func.
Muscular strength for arms	Kizami Zuki + Gyaku Zuki	10 sec.	Right	2.41	0.32	5.29	0.45	2.88	54.44%	4.32	Stat. Func.
			Left	1.69	0.88	3.61	0.91	1.92	53.18%	4.28	Stat. Func.
Agility	Kiyago Zuki + Mawashi Geri + Mai Geri	10 Sec.		0.85	0.15	2.25	0.51	1.40	62.22%	5.32	Stat. Func.
Compatibility	Ao Uchi + Age Ushiro + Mai + Kiage	20 Sec.	Right	1.65	0.33	3.69	0.64	2.13	57.72%	4.25	Stat. Func.
			Left	1.22	0.41	5.21	0.58	3.99	76.58%	3.62	Stat. Func.
Arm speed endurance	Kizami Zuki + Gyaku Zuki	20 Sec.	Right	1.52	0.32	3.69	0.62	2.17	58.80%	4.25	Stat. Func.
			Left	1.63	0.35	4.26	0.28	2.63	61.73%	5.32	Stat. Func.
leg speed endurance	Mawashi Geri + Mai Geri	30 Sec.	Right	3.52	0.44	6.52	0.62	3.00	46.01%	3.85	Stat. Func.
			Left	4.32	0.16	8.32	0.19	4.00	48.07%	4.36	Stat. Func.
Arm power endurance	Kizami Zuki + Gyaku Zuki	30 Sec.	Right	3.61	0.32	5.97	0.51	2.36	39.53%	4.32	Stat. Func.
			Left	4.52	0.19	7.62	0.20	3.10	40.68%	3.30	Stat. Func.
Muscular power endurance for the legs	Mawashi Geri + Mai Geri	30 Sec.	Right	5.62	0.31	7.65	0.38	2.03	26.85%	4.36	Stat. Func.
			Left	7.32	0.97	9.25	0.42	1.93	20.86%	3.64	Stat. Func.

Follow Table (11)

Significance of differences between pre-measurements and post-measurements in the level of physical skill variables (n=12)

Tests	Skills	Measurement Unit	Direction	Pre-measurement		Post-measurement		Differences between the averages	Improvement percentage	Value (t)	Significance Level
				Mean	Standard Deviation	Mean	Standard Deviation				
Muscular power endurance for the arms and legs	Kizami Zuki + Kizami Mawashi	30 Sec.	Right	8.32	0.91	9.67	0.81	1.35	13.96%	3.48	Stat. Func.
			Left	5.85	0.64	7.70	0.67	1.85	24.02%	4.32	Stat. Func.
Agility endurance	Kiyago Zuki + Mawashi Geri + Mai Geri	35 Sec.		1.95	0.75	3.69	0.88	1.74	47.15%	3.98	Stat. Func.
Performance endurance for the legs	Mawashi Geri + Mai Geri	40 Sec.	Right	7.62	0.49	9.54	0.56	1.92	20.12%	4.40	Stat. Func.
			Left	5.25	0.99	7.59	0.91	2.34	30.83%	4.32	Stat. Func.
Performance endurance for the arms	Kizami Zuki + Gyaku Zuki	40 Sec.	Right	11.25	0.67	14.65	0.81	3.40	23.20%	4.26	Stat. Func.
			Left	10.22	0.85	13.52	0.91	3.30	24.40%	3.69	Stat. Func.

The tabulated (t) value at the significance level (0.05) = 1.666.

It is evident from Table (11) that there are statistically significant differences between the means of pre-measurements and post-measurements in the level of physical skill variables, as the tabled (t) value is greater than the calculated value.

Table (12)

Significance of differences between pre-measurement and post-measurement in the level of Herman Control Scale (n=12)

Variables	Measurement Unit	Pre-measurement		Post- measurement		Differences between the averages	Improvement percentage	Value (t)	Significance Level
		Mean	Standard Deviation	Mean	Standard Deviation				
Direction (A)	Degree	8.62	0.97	10.69	0.91	2.07	19.36%	6.52	Stat. Func.
Direction (B)	Degree	9.11	0.84	12.32	0.64	3.21	26.05%	4.58	Stat. Func.
Direction (C)	Degree	7.19	0.69	9.67	0.87	2.48	25.64%	4.36	Stat. Func.
Direction (D)	Degree	7.51	0.82	9.87	0.69	2.36	23.91%	3.85	Stat. Func.

The tabulated (t) value at a significance level of 0.05 is 1.666.

It is evident from Table (12) that there are statistically significant differences between the pre-measurement and post-measurement means in the level of the Herman Control Scale for the research sample, as the calculated (t) value is greater than the tabulated one.

Table (13)

Significance of Differences Between Pre-measurement and Post-measurement in the Level of Performance in Kata (n=12)

Variables	Measurement Unit	Pre-measurement		Post-measurement		Differences between the averages	Improvement percentage	Value (t)	Significance Level
		Mean	Standard Deviation	Mean	Standard Deviation				
Skill Performance Level in Kata	Degree	20.19	1.98	24.52	1.98	4.33	17.65%	6.85	Stat. Func.

The tabulated (t) value at a significance level of 0.05 is 1.666.

It is evident from Table (13) that there are statistically significant differences between the means of pre-measurements and post-measurements in the level of skill performance in Kata. The tabulated (t) value is greater than the calculated value at a significance level of 0.05, with a significance percentage of 17.65%.

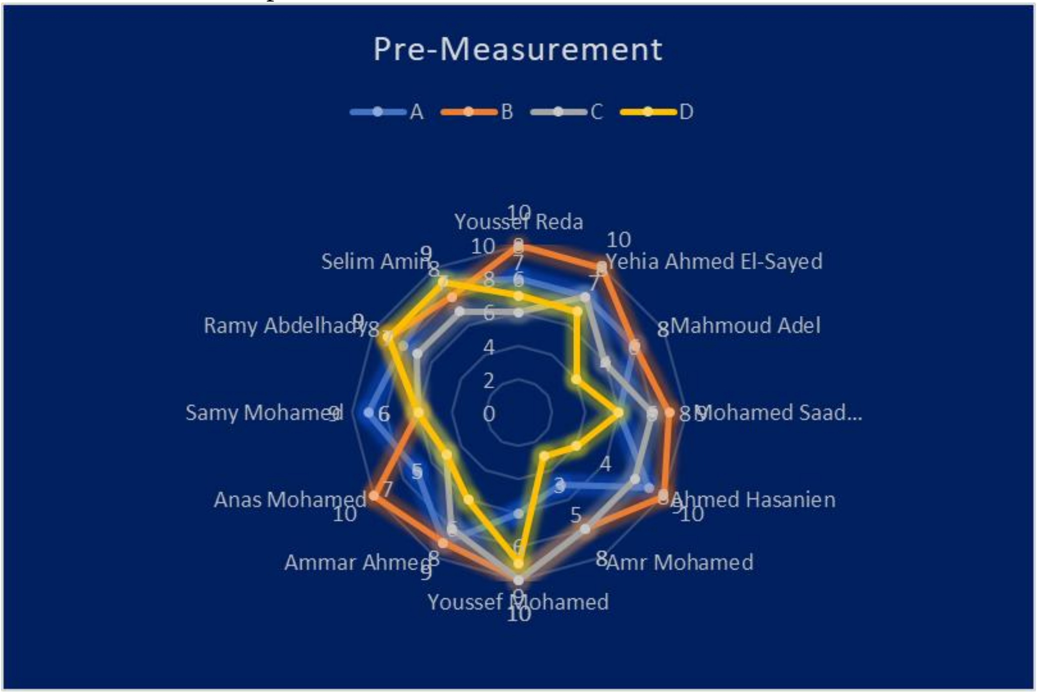
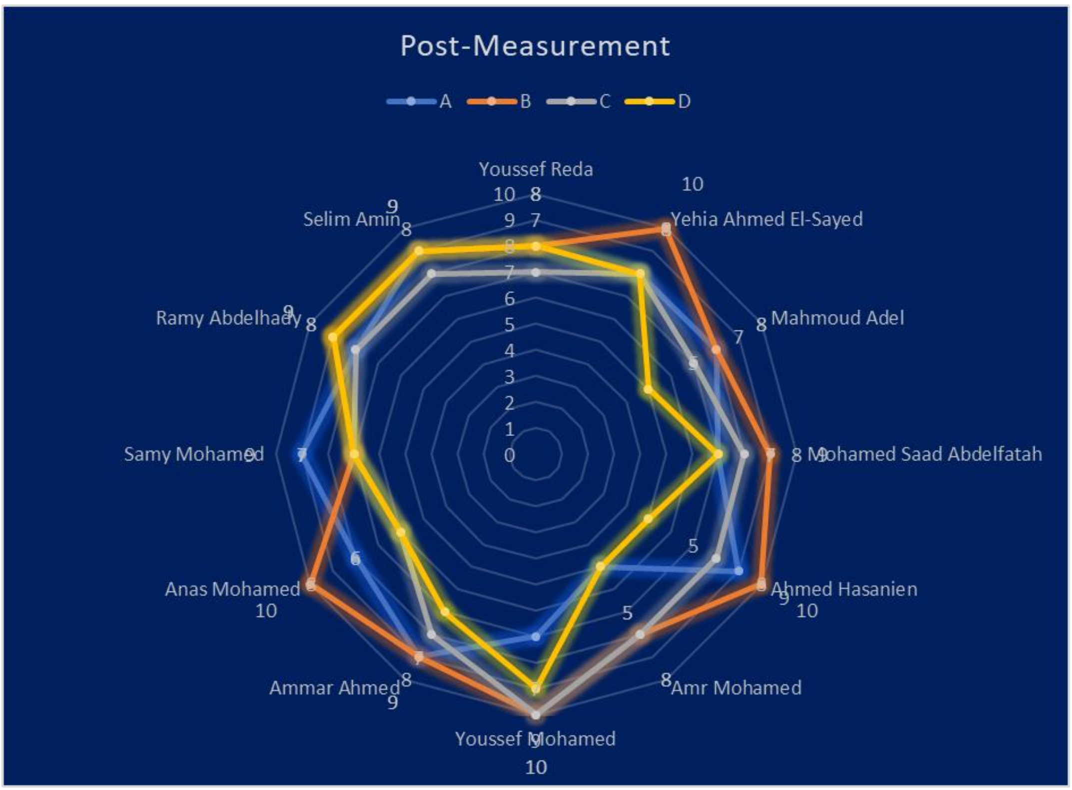


Figure (2)



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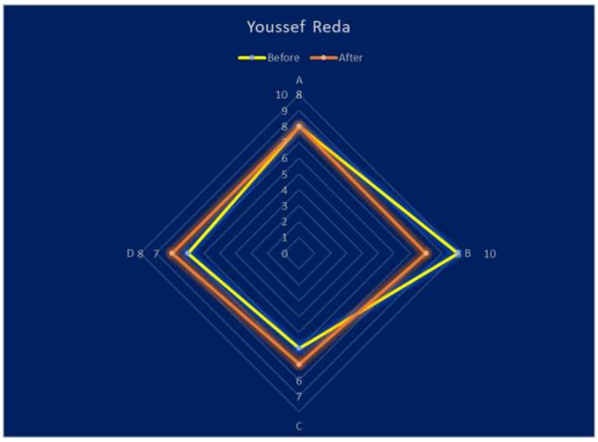

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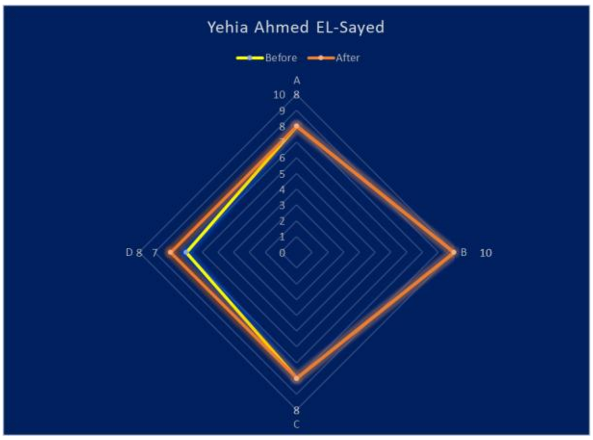

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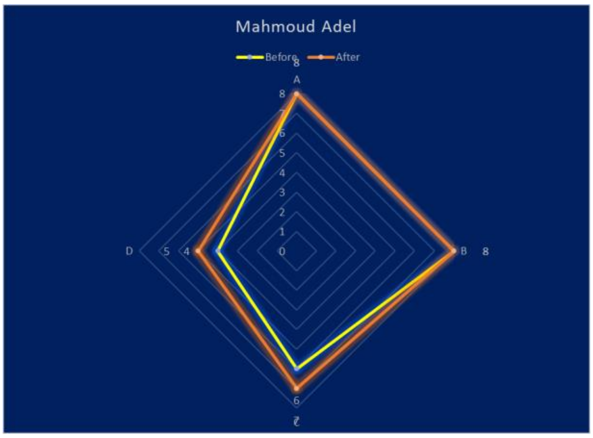

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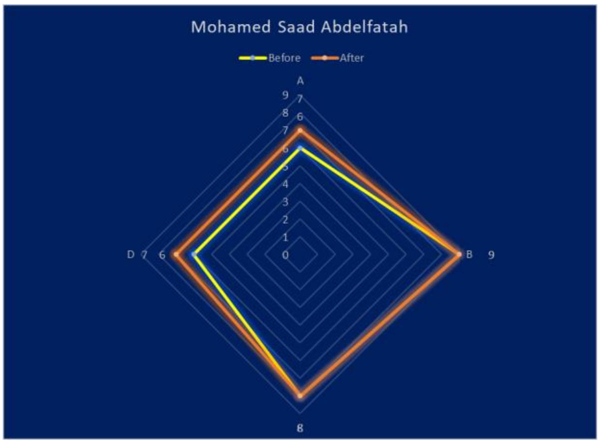

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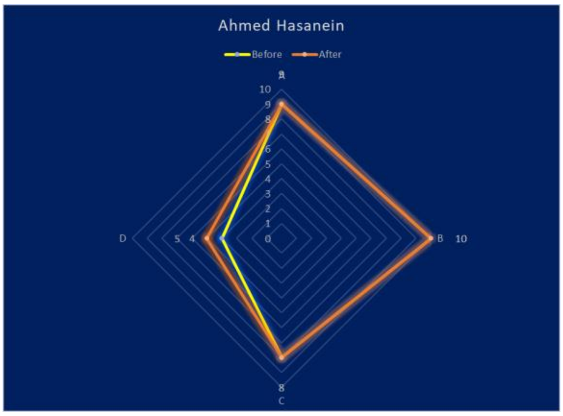

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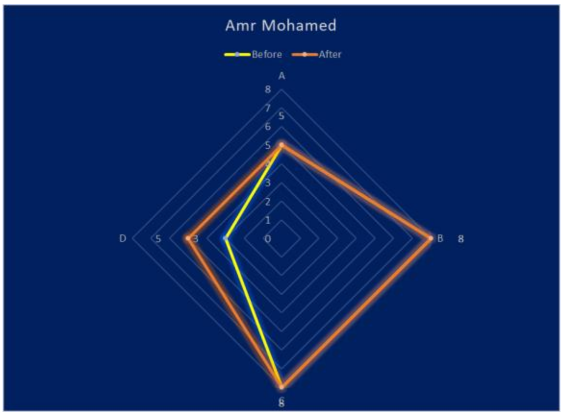

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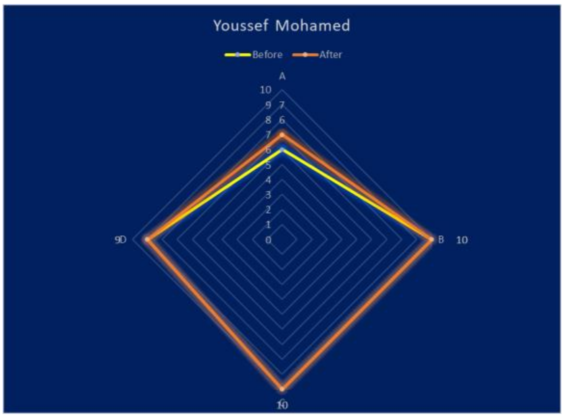

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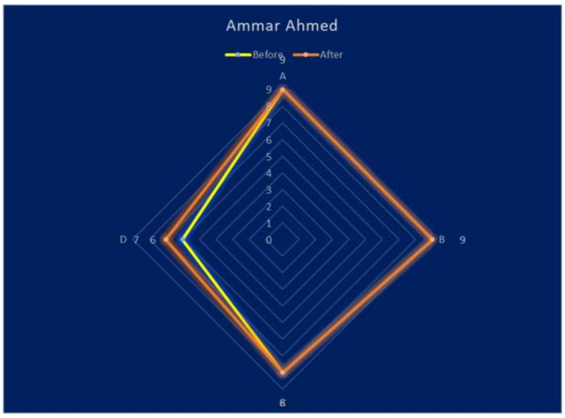

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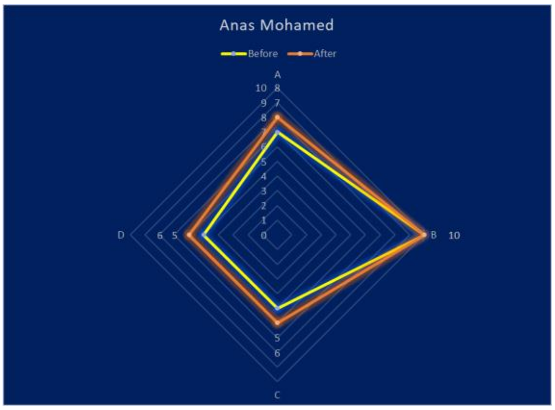

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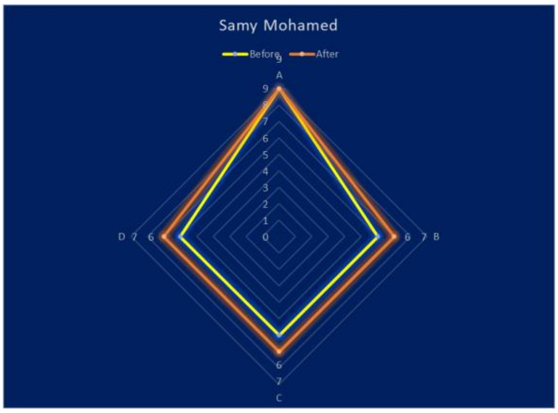

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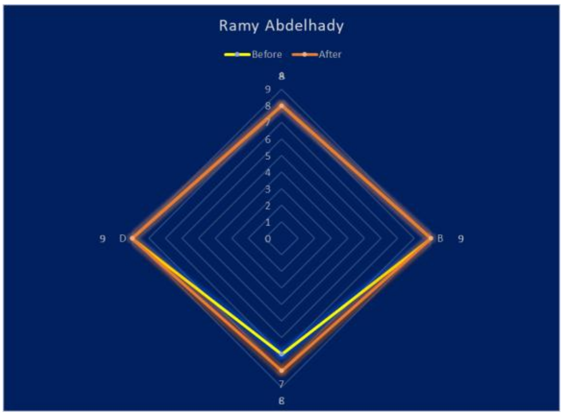

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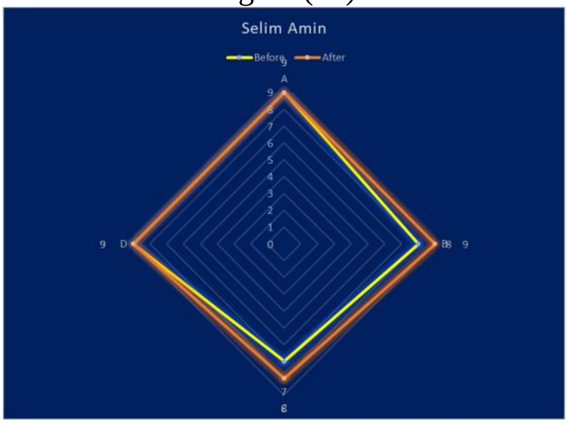

Figure (15)

From Table (11), statistically significant differences are evident between the mean values of pre-measurements and post-measurements in the level of physical motor skills. The tabulated (t) value is greater than the calculated value, with an improvement percentage ranging from 13.96% for the element of performance endurance for the right legs to 76.58% for the element of left-sided coordination.

The researcher attributes this improvement to the Brain Gym program, as the largest improvement percentage occurred in the element of left-sided coordination. The program includes exercises to develop neuro-muscular coordination, given the performance of Kata at its horizontal and vertical levels. Additionally, performing Kata from a single step requires focusing on performance and avoiding pre-memorized patterns, contributing significantly to the development of coordination and various physical fitness elements.

This aligns with the views of José M. Cancela and others (2014), who suggest that Brain Gym exercises have a significant impact on physical fitness and complement traditional exercises. Additionally, Joanne Ingrid Robot et al. (2019) argue that brain exercises are a form of physical fitness that not only utilizes physical activity but also requires coordination of body movements. Physical fitness elements include strength, speed, accuracy, endurance, agility, flexibility, coordination, and balance. Brain exercises, as a form of physical activity, help protect nerve cells from degeneration. They also have additional benefits, such as reducing depression, anxiety, and stress levels, particularly in students facing increased academic workload. A brain exercise program based on movement characteristics can activate the musculoskeletal system in a balanced and appropriate manner, influencing physical fitness components to enhance student fitness. Moreover, increased student attention has a significant impact on improving short-term memory. The exercises contribute to the improvement of short-term memory due to the mental exercises that enhance focus and attention (Joanne Ingrid Robot et al., 2019).

According to Dennison and Gaul (2006), the Brain Gym program relies on the characteristics of movement to activate the musculoskeletal system sufficiently and in a balanced manner. This has an impact on components of physical fitness, allowing for the correction of faults.

Dikir, Badi’ah, and Fitriana (2016) confirm that the use of the Brain Gym program results in an increase in physical fitness indicators, particularly when combined with additional brain exercises. Based on the Wilcoxon test in their study, it was found that incorporating physical exercises alongside brain exercises can increase physical fitness indicators. Brain exercises also affect physical fitness components, as the given bodily movements can enhance understanding and contribute to learning the principles of movement mechanics. This, in turn, facilitates the training of motor skills. Brain exercises, as applied, consist of diverse kinetic structures that enhance strength, speed, endurance, agility, and balance. Non-motor patterns, facilitated by motor movements, contribute to improving flexibility and static balance, ultimately developing coordination in children.

Hafez (2017) supports this by noting that the complexity of movements in brain exercises, compared to those in non-brain exercises, leads to an improvement in neural levels. This complexity results in the release of important hormones such as Brain-Derived Neurotrophic Factor (BDNF) from the brain, with the anterior midbrain showing an increase in comparison.

Thomas (2012) also agrees with this, stating that brain exercises significantly impact the function of every part of the brain. The movements involved activate the brain, causing it to respond to changes in body movement.

Hafez (2017) mentions that brain exercises given over an 8-week period yielded improvements in dynamic balance tests and increased skill levels in beginner gymnasts. Brain exercises contribute to enhancing elements of balance, composure, body movements, coordination, rhythm, kinesthetic sense, requiring collaboration among all body joints, especially in response to stimulation.

This aligns with the perspective of Mohammed Al-Tikriti (1988), emphasizing the direct relationship between the physical structure of the mind and the activities performed by an individual. The increase in neuronal branching in nerve cells assists in enhancing communication between neurons, resulting in more places for storing larger quantities of information and skills acquired by an individual, relevant to their profession or activity.

The addition of brain exercises also contributes to an increase in physical fitness indicators, as these exercises can stimulate sensory and motor skills, improving the brain's ability to organize incoming sensory information, whether internal or external. This is due to the movement element in brain exercises, which primarily affects the musculoskeletal system, influencing fitness components such as muscle strength, muscular endurance, explosive muscular strength, speed, flexibility, agility, precision, balance, and coordination. Siamy et al. (2015) suggest that practicing brain exercises leads to an increase in dynamic balance and improvement in skill performance.

Thus, the first hypothesis is confirmed, which states that there are statistically significant differences between the pre-measurement and post-measurement averages in physical skill performance in favor of the post-measurement.

This is evident from Table (12), showing statistically significant differences between pre-measurement and post-measurement averages in the level of the Hermann Scale questionnaire for the research sample. The critical (t) value was greater than the calculated value, with an improvement percentage ranging from 19.36% for section (A) to 25.64% for section (C). The researcher attributes this improvement to the practice of the Brain Gym program, as it relies on skill performance in a way that stimulates more nerve cells and involves a larger number of them.

This aligns with what Tarek Mohamed Badr Al-Din (2016) mentioned, stating that when a player engages in learning a new skill, there is the generation and construction of new neural connections in the brain's cortex. Furthermore, when a player engages in training for a previously learned motor skill, the brain increases the blood vessel density for those neural connections in the brain cortex.

This is consistent with David Sousa (2009), who pointed out that the majority of individuals have one hemisphere of the brain more active than the other. By identifying which hemisphere is more active in an individual, it is possible to understand their personality traits, capabilities, learning style, as well as their preference for processing and organizing information. This explains why we succeed in accomplishing certain tasks more than others.

This agreement is also supported by Tarek Badr Al-Din and Amna Mohamed Hussein (2017), emphasizing that each individual has a unique brain capable of learning, gaining experiences, analysing information, and problem-solving through behavioural situations that align with this uniqueness. If the appropriate conditions are provided for an individual to shape their brain based on their cognitive control, their ability to learn increases by stimulating nerve cells, forming a greater number of neural connections, and establishing communication between these connections and nerves, resulting in what is known as brain-based learning. This agrees with the study conducted by Tarek Badr Al-Din and Amna Mohamed Hussein (2017) and Wahba Allah Jaber (2016), indicating that the preferred pattern for practitioners of martial arts activities, especially individual activities, is pattern "C," which corresponds to the lower right side of the brain, the emotional human area, with a lower percentage in pattern (A).

Taufik Rihatno (2017) also believes that the human brain is specialized for specific tasks. Brain Gym movements are applied to stimulate the lateral dimensions of both the right and left hemispheres of the brain. Lateral dimension, through integrating the body sides (bilateral integration), works in the "middle field." Achieving this movement stimulates coordination between the brain hemispheres, a fundamental cognitive ability, such as processing linear code, written symbols, hearing, and vision. The sides of the human body are divided into the left and right sides, allowing control over one side, for example, writing with the right or left hand, as well as integrating both sides of the body (bilateral integration).

This aligns with the findings of Joanne Ingrid Robot et al. (2019), stating that the Brain Gym program can strengthen neural connections, making the brain more sensitive to incoming information. The internal representational areas of the brain experience an increase due to the formation of new pathways, creating bridges between nerve cells or new neural junction points. Brain exercises can stimulate movement, and the shaping of movement can impact the brain. Strengthening neural connections supports better movement stimulation, leading to more coordinated movements and improved balance. The broader internal representation enhances body posture, even during different movement variations, ultimately improving overall performance during brain exercises.

Joanne Ingrid Robot et al. (2019) add that incorporating brain exercises will activate brain integration mechanisms. Improving short-term memory scores may be a reason for this group's presence, indicating an enhancement of functioning on both hemispheres of the brain. Integration occurs in both brain hemispheres through movement, with gymnastic movements acting as a bridge connecting the brain and the body. The brain controls all bodily functions, and performing movements to access all brain regions that can be reached allows for the integration of relationships in the learning process, stimulating students to achieve maximum benefit. The use of both hemispheres of the brain directly contributes to improving memory, attention, and physical fitness.

Dikir, Y., Badi'ah, A., and Fitriana, L.B. (2016) affirm that after giving brain exercises, the person's attention rating scale increased by 0.13. Movements in brain exercises can activate the organs and systems in the human body through the nervous system, achieved by dividing movements into three dimensions: lateral dimension, focus dimension, and central dimension. These dimensions are related to specific brain functions, describing the brain's overall use in the learning process. The three-dimensional pattern in brain exercises aims to create harmony, allowing for the integration of access to rapid rotation and slow rotation in these three dimensions. Creating a state of balance is only possible if the three dimensions work consistently together. According to Church, M. (2018) in his review of "Brain Gym for People in Sport," he states that brain exercises in sports aim to achieve maximum coordination between the mind and body through integrated responses. This integration can enhance optimal performance for individuals and even teams in any sport. The development of coordination involves spatial awareness, allowing individuals to appreciate distance through the process of perception. It requires observation and thoughtful consideration of the surrounding environment so that individuals can interpret and give meaning to stimuli through sensory processing. This process occurs in the brain. Movement in brain exercises can help understand the principles of biomechanics, enabling a better comprehension of the movement process (Church, M. 2018).

Thus, the second hypothesis is confirmed, which states that there are statistically significant differences between the pre-measurement and post-measurement averages in the four sections of cognitive control in favor of the post-measurement.

It is evident from Table 13 that there are statistically significant differences between the pre-measurement and post-measurement averages in the skill performance level in Kata. The tabulated (t) value is greater than the calculated value, with a significance level of 0.05. The improvement is by a percentage of 17.65%. The researcher attributes this enhancement to the Brain Gym program, as it was the sole training method applied throughout the program duration for Kata.

Taufik Rihatno (2017) believes that in Brain Gym, learning involves unlocking the full potential of your mind through updating movement patterns and Brain Gym activities. This helps gain control over parts of the brain that were previously hindered. Changes in learning and behavior can be rapid and profound, as practitioners find ways to receive information and express themselves, leading to improvement in skills and performance.

In the traditional style of education and training, the focus is more on lateral movements, moving naturally from right to left, aiming to develop both the right and left hemispheres of the brain. Through movement training in Brain Gym, it is expected to help balance the brain's function by collaborating across the three dimensions. This achieves balance in the entire system, facilitating communication, understanding, and organization. Simultaneously, rhythmic, low-impact, high-intensity fitness movements adapt to students' abilities without neglecting warm-up, core, and cool-down elements, aiding in rapid performance development. (Taufik Rihatno, 2017)

Thus, the third hypothesis is confirmed, which states that there are statistically significant differences between the pre-measurement and post-measurement averages in kata performance in favor of the post-measurement.

It is evident from the figure (2,3,4,5,6,7,8,9,10,11,12,13,14,15) that the brain print of the players did not change, but there was a change in some players' scores in each pattern.

The researcher believes that, after consulting with experts in neuropsychology, it is challenging to completely change the brain fingerprint of a player, and it is nearly impossible for significant changes to occur in a short period. The brain fingerprint illustrates the player's thinking process, preferences, and the tasks in which they excel. The researcher sees the obtained results, showing very slight changes in the players' scores in both pre- and post-assessment, as a result of "Brain Gym" exercises. It is anticipated that the brain fingerprint may not undergo complete transformation, but rather partial changes in some players' scores, as indicated in the previous figures. The primary goal of understanding the players' brain fingerprint is to guide them towards suitable activities. The objective of "Brain Gym" training is to enhance neural connections, contributing to the long-term development of the players' patterns, particularly.

This aligns with Tarek Badr El-Din's perspective in 2016, stating that the brain print helps guide young individuals towards the type of sports they excel in, provided their brain print aligns with the psychological requirements of that sport (Tarek Mohamed Badr El-Din 2016). Herman's theory, which explains the brain print, proves highly beneficial in professional development processes, testing, selection, guidance, as well as in classification, evaluation, and assessment mechanisms in all aspects of life (Tarek Mohamed Badr El-Din 2016).

Thus, the fourth hypothesis, which suggests improvement ratios in the brain print in favor of the post-test measurement.

Thanks, and appreciation to Dr. Tarek Badr El-Din, Professor of Sports Psychology at the Faculty of Education, Alexandria University, and to Mr. Ahmed Hassan, the coach of Hero Sport Academy team, and all the players who participated in the research.

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