Effect of Brain Gym Technique on Community Health Nursing Students' Multiple Intelligences, Knowledge and Information Retention

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Abstract

Background: Brain Gym is a simple and pleasant movements, consists of 26 simple movements that are believed to enhance academic and behavioral performance by activating both hemispheres of the brain through neurological re-patterning to promote whole brain learning. **Settings**: this study was carried out at community Nursing Department, Faculty of Nursing- Alexandria University. Method: A quasi experimental research design was used to conduct this study using two tools "Tool I Howard Gardner Multiple Intelligence Test, Tool II: Achievement Retention Test" **Sample**: systemic random sample (every other one) was used. **Results:** of the present study revealed that there were statistically significant differences between study and control groups and within study group before and after the application of brain gym technique in the favor of study group after the application regarding all types of multiple intelligence and achievement retention test total score. **Conclusion**: Community health nursing students who were subjected to brain gym technique had better intelligence, knowledge and retention score than those of the control group. **Recommendations** of this study included that brain gym technique should be incorporated in nursing theory and clinical education to improve the level of students' knowledge and retention.

Keywords: Brain gym, multiple intelligences, knowledge, information retention, nursing students.

Introduction

Human brain is not a constant organ, it can be developed by many innovative ways one of them is brain gym, which was created in the 1970s by educators and reading specialists Paul and Gail Dennison to increase a variety of outcomes such as attention, memory, and academic skills. This intervention involves participants to perform a range of motions in order to help the body recall motions from when they were learning to coordinate their hands, eyes, ears, and entire body in the early stages of life. Brain Gym is a set of 26 simple motions that are thought to improve academic and behavioral performance by stimulating both hemispheres of the brain through neurological reprogramming and promoting whole-brain learning. By combining the left and right sides of the brain **(Garnett., 2005 , John et al., 2014).**

Brain gym technique is divided into three categories with subtypes; lateralization, centralization and focalization. The first category is lateralization / midline, which is concerned with the way of interaction between the left and right hemispheres. The second category is focalization, it is

concerned with the growth and reinforcement of neural pathways that connect what people currently knows (at the back of the brain) to their ability to process and express information (in frontal lobes). The third category, centralization, is involved with relaxation exercises that aid in the re-establishment of neuronal networks between the brain and the body. It helps the chemical and electrical processes take place during mental and physical exertion by facilitating the passage of electromagnetic flux through the body. **(Spaulding., 2010 ,Luria et al., 2011 , Pederson., 2016).**

Brain gym movements include firstly Lateralization / midline movement. It comprised Lazy 8s motion by; drawing horizontal eights in the air with hands or eyes. Cross the midline of the body motion is alternatively moving the arms towards the opposite leg and vice versa. Double doodle motion is a bilateral drawing exercise in which both hands are used to sketch two images at the same time. While the elephant motion is a series of eight slow motions in which the eyes gaze beyond the hand and the entire body moves in sync with the arm movement. Rolling the neck motion by moving the head forward and turning from side to side. Rocking the hips motion by rolling the hip one at a time in a motion while sitting **(Espinosa.,2011 , Grabe., 2014).**

Regarding belly breathing motion: it expands the rib cage from front to back, left to right, and top to bottom to breathe. Cross crawl sit-ups motion is performed by sitting on your back with your knees and head up, clasping your hands behind your head, touching one elbow to the opposing knee, then alternating. While energizer action done by sitting comfortably, placing hands on a desk (fingers pointing internally), breathing, and slowly elevating head and upper back . Consider the X motion by closing your eyes, envisioning the letter X, and seeing how your vision resembles the letter X. Your eyes work together to connect the left, right, upper, and lower visual fields around a center of focus. **(Peach., 2007, Eggleston., 2011).**

The second movement is Focalization /lengthen, consisting of the Owl motion through re-establishes the width of movement by stretching the muscles of the neck and shoulders. Also lifting the arm while keeping the head relaxed, lifting away from the head and front, back toward the ear is the active arm motion. The foot flexes motion by a sitting position with one ankle resting on the other knee and the foot flexed. The calf pump motion is bracing oneself against a wall, placing one leg behind the other, and leaning forward. Furthermore sitting comfortably, bending forward, allowing gravity take over, crossing one foot over ankles, and reaching forward is the gravity glider motion. While sitting on a padded surface on the floor with knees bent and feet together in front, leaning back with body weight on hands and hips, rocking body in small circles, or back and forth, is the whole rocker motion. **(Naset., 2006 , Robinson et al ., 2011).**

The third movement group is Centralization / energy exercise. Firstly one hand massages two points below the clavicle while the other rests on the navel is the brain buttons motion. While the motion of the earth buttons done by one hand resting on the lower lip while the other rests on the pubic bone. Balance button motion is done by holding the place where the skull sits over the neck and gently pressing the head back. The motion of the space buttons is one hand

resting on the upper lip and the other on the backbone. Energy yawn action done by yawning while holding tense places on the jaw and massaging. Associated with thinking cap motion by softly dragging ears backward and unrolling them with fingers, starting at the top of the ear and softly massaging them all the way to the lobe. Positive point motion is done by crossing the left ankle over the right motion by intertwining fingers, and bringing them close to the chest is the hook-ups action, relax by closing eyes and breathing deeply for a few minutes. Then, while inhaling deeply, liberate your hands, legs, and finger tips. It is delicately touching the point above the eye in a **(Gardner., 2002 , Gosbey., 2013).**

Brain gym movements can be assessed through its effect on the improvement of students multiple intelligences based on its indirect effect on the brain through specific body area. Multiple intelligences is a set of natural intelligences proposed by Gardner (1983-2007), who defined intelligence as a bio psychological potential information process that can be activated in a cultural setting to solve problems or create products. It empowers learners but does not restrict them to one modality of learning. He articulated eight intelligence types stating that each individual possesses a unique blend of all intelligences. It includes musical/rhythmic, visual/spatial, verbal/linguistic, logical/mathematical, bodily/kinesthetic, interpersonal, intrapersonal, naturalistic and existential intelligences **(Eggleston., 2011 , Ewen et al., 2011).**

Regarding musical/rhythmic intelligence, it deals with sensitivity to sounds, rhythms, tones and music. People with a high musical intelligence normally have good absolute pitch, sensitivity to tone, melody or timbre, able to sing, play musical instruments and compose music. while visual/spatial intelligence; deals with spatial judgment, the ability to visualize with the mind's eye, the ability to perceive the visual world accurately and to perform transformations and modifications upon one's own initial perceptions via mental imagery. Functional aspects of spatial intelligence include artistic design, map reading and working with objects **(Gardner., 2002).**

In addition, verbal–linguistic intelligence encompasses the capacity to successfully employ words for reading, writing, speaking, storytelling, and memorizing words, dates, and languages. Explanations, descriptions, and expressiveness all require linguistic ability. Furthermore, logical / mathematical intelligence is concerned with logic, abstractions, numbers, logical reasoning, problem-solving, critical thinking, and the ability to comprehend the causal system's basic principles. While physical–kinesthetic intelligence based on the control of one's physical actions and the ability to handle items skillfully are the foundations of. This involves the ability to train reactions, as well as a sense of time and a strong sense of physical action aim. People with high bodily-kinesthetic intelligence excel at physical activities including athletics, dance, acting, and crafting. Athletes, dancers, musicians, actors, and police officers, according to Gardner, are vocations that suit him. (**Mc Charty., 2000 , Barnum., 2003).**

Regarding interpersonal intelligence it is characterized by sensitivity to mood shifts, sentiments, temperaments, motivations, and the capacity to work together in a group setting. People with strong interpersonal intelligence are good communicators, can

sympathize with people readily, can be leaders or followers, and love debate and discussion. Salespeople, legislators, managers, teachers, and social workers, according to Gardner, are vocations that suit them. Intrapersonal intelligence, on the other hand, is concerned with introspective and self-reflective abilities. This refers to a thorough understanding of oneself, one's strengths and shortcomings, and what makes one unique, as well as the ability to foresee one's own behaviors and emotions. Naturalistic intelligence also involves cultivating and connecting information to one's natural environment. As a classification system for animal and plant species, it is based on ecological receptivity that is profoundly rooted in a sensitive, ethical, and holistic view of the world. Furthermore, existential intelligence is defined as the ability to be sensitive to, or have the potential for conceptualizing, deep concerns regarding human existence, such as the meaning of life, why humans are born and die, and so on. **(Kovalik., 2009 , Espinosa., 2011 ,Robinson et al., 2011).**

Brain gym can be assessed also through academic achievement and information retention which refers to how far a student, instructor, or institution has progressed toward their short or long-term educational objectives and completed their educational milestones as bachelor's degrees. Academic achievement is best measured immediately after the course completion. If it measured after a period of time at least 21 days from the course completion it acquired a new function which is measuring information retention**.(Areepattamannil.,2008)**. The study seeks to help Community health nursing students by demonstrating how brain gym movements can be used to increase students' multiple intelligences and their achievement and information retention via an indirect influence on the brain through the specific body area movements.

Aim of the study is to:

Assess the effect of brain gym technique on community health nursing students' multiple intelligence, knowledge and information retention.

Research Hypothesis:

- Students who trained with brain gym movements' technique get higher score in multiple intelligence tests than those who do not.
- Students who trained with brain gym movements' technique get higher score in knowledge test than those who do not.
- Students who trained brain gym movements' technique get higher score in retention test than those who don't.

Materials and method

Materials

Research design:

A quasi experimental research design was used to fulfill the aim of the present study.

Settings:

The current study was conducted at Community Nursing Department, Alexandria University, Faculty of Nursing / Egypt.

Subjects:

The subjects in this study were 204 nursing students who represented the entire students enrolled in "Community Nursing course" during the first semester

of the academic year (2019-2020). The subjects were divided into two equal groups by systemic random sample (every other one); study and control, each with 102 students.

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Quantitative data were described using mean, standard deviation. Significance of the obtained results was judged at the 5% level.

Tools:

Tool I: Howard Gardner Multiple Intelligence Test.

This tool was developed by Gardner in 2007 **(Gardner., 2007)**. It was adopted by the researcher to assess the types of students' multiple intelligences. It consisted of 102 items with double scale of (Y), which meant present and (N), which meant not present. The total score was calculated by determining the total score of (Y) and the total score of (N) then subtracted the score of (N) from (Y). The median was calculated for each intelligence for all students then drew a graph for all students to determine what the intelligences above the graph line (with positive score) which is the preferred and what is below the line (with negative score) which is not preferred. The student's intelligence types were determined as linguistic/ verbal, logical/ mathematical, spatial/ visual, bodily/ kinesthetic, musical, naturalistic, existential, interpersonal, and intrapersonal. This tool was attached with socio demographic and academic characteristics sheet includes as age, sex, GPA, English level and computer skills.

Tool II: Achievement Retention Test

The researcher created this tool after examining related literature and course objectives to assess students' achievement and information retention. **(Barnum., 2003)**. It consisted of 2 categories: True and false questions (10 items/10 grades), MCQ (20 items/ 20 grades). The overall score was 30, and it was interpreted as follows: strong achievement/retention levels ranged from 30 to 20, moderate achievement/retention levels ranged from 9 to 10, and low achievement/retention levels ranged from 9 to less. The higher the score, the better the achievement and retention.

Method

- An approval from the Ethical Research Committee and the Dean of the Faculty of Nursing and the Head of the Community Nursing Department at Alexandria University after explaining the study's purpose and assuring the privacy, anonymity, and confidentiality of the collected data

- Each Community nurse student signed a written informed consent form after explaining the aim of the study and they give the right to refuse the participation in the study.

- Tool **I** was developed, tool **II** was adopted from **(Gardner. 2007)** and **(Barnum., 2003)**.

- Tools Validity:

all tools were reviewed by five experts in the fields of Community Nursing and Nursing Education for substance and validity, and any necessary changes were made.

-**Tools reliability**:

all tools tested by Cronbach's alpha test , and they were reliable, with a test coefficient Cronbach's Alpha value for tool I was 0.749 and for tool II was 0.703.

- **A pilot study:**

Was conducted on 10% of the sample size to check clarity, feasibility, applicability of tools, obstacles encountered, and the time required to fill out the tools. As a result, the necessary modifications were done.

- The students were assigned to the following groups at random: It was a study group of 102 community nursing students who were given brain gym activities between lectures. The control group consisted of 102 nursing students who received standard lectures without any breaks.

Data collection:

Data collection started at the beginning of October 2019 and ended by February 2020.The study tools were used as following; Tool I was used twice: first as a pre-test before the application of brain gym and secondly as a post-test immediately after the application. Tool II was used three times: once as a pre-test before the application, second as a post-test immediately after the application, and finally as a retention test 21 days from ending the application.

The study was carried out through three phases:

1.**The preparatory phase**:

During this phase, researchers used proper researcher preparation and procedure to try to find a true meaning for the new concept

a.Researcher preparation

- Reading all available evidence concerning brain gym methodology, whether new or old, until the time of data collection from books, digital libraries, and websites, including national and international study on the subject.

- Self -training on brain gym technique movements

b. Content preparation

- The researchers devised a timetable plan for each lecture in order to incorporate the brain gym methodology within the original lecture period.

2.**The Implementation phase:**

During this phase, the researcher used the tools I and II to assess students' multiple intelligences and knowledge for both the study and control groups. The brain gym methodology was used over four lectures over four weeks, one lecture per week, with each session lasting approximately 120 minutes.

It began during the second semester of the faculty of nursing's third academic year, 2020-2021. The researchers divided each lecture into four sessions, each of which lasted 30 minutes and included 20 minutes of subject explanation and 10 minutes of break during which the students were applied brain gym exercises of three categories.

3.**The Evaluation phase**:

During this phase, researchers tested students in both the study and control groups to evaluate their multiple intelligences and knowledge level using tool I, II immediately at the end of the application, and their information retention level using tool II 21 days after the application ended.

Ethical consideration:

- A written informed consent from students to participate in the study was obtained before data collection and after explanation of the aim of the study.
- Privacy of the study participants was asserted.
- Confidentiality of the collected data was assured.
- Participants' voluntary participation and their right to withdraw from the study at any time were emphasized.

Statistical analysis:

The IBM SPSS software package version 20.0 was used to examine the data provided into the computer. IBM Corp., Armonk, NY Numbers and percent were used to describe qualitative data. The mean and standard deviation were used to describe numerical data. The significance of the acquired results was determined at a 5% level of significance.

Results:

Table (1):showed that the distribution of the nursing students who were studied based on their qualities In terms of demographic data, the control and study groups had about equal distributions of age and sex groups, with about half of the nursing students in both groups being 21 years and were female (51, 52, 59%).Also, one third of both study and control group had B+ (29.4, 30.4%) respectively while about half of both groups had very good English level (50, 51%) and half of both groups had good computer skills (54.9, 51%). No statistical significant differences were identified between study and control groups.

T**able (2): revealed that** the comparison between the median of the study and control groups' students according to their multiple intelligences before and after the application of brain gym. It was found that there were elevation in the study group's median of all types of multiple intelligences in after than before the application in the favor of after the application(6,8,7,6,7,6,6,7,6)(-1,4,-2,4,3,3,5,2,2) respectively . There were also statistically significant difference in all types of multiple intelligences and total score between the study and control groups, as well as within the study group, before and after the application of the brain gym approach in favor of the study group after the application where (P=0.-000) respectively. Regarding control group the median nearly remain the same after as before (2,2,-1,4,2,3,4,2,2)(1,2,-2,4,2,3,4,2,2) respectively

Figures (1, 2) illustrated the comparison between the median of the study and control groups' students according to their multiple intelligences before and after the application of brain gym. Regarding fig (1) there were elevation in the bars of study group after than before with consideration that linguistic and musical intelligences were at the negative side before the application. Regarding fig (2) the bars of control group nearly remain the same in before and after with consideration of musical intelligence are on the negative side before and after the application.

Table (3): illustrated the comparison between the mean and standard deviation of the study and control groups' according to their achievement retention test before and after the application of brain gym. In relation to the study group, it was found that there was elevation in the mean and

standard deviations after the application of brain gym than before (19.9 +- 0 .4) (0.8+- 0.9) respectively. While the retention test mean was the same as the achievement posttest and the standard deviation was elevated (19.9+- 0.7).

As regards the control group, there was elevation in the mean and standard deviations after the application than before (8.2+- 2.2) (0.7+- 08) respectively, while the retention test mean and standard deviation decreased (7+-1.4).Moreover there were statistically significant difference in achievement and retention test results between the study and control groups, as well as within the study group, before and after the application of brain gym in the study group's favor as p (0.001). There was no statistically significant difference in the control group before and after the application. .

Table (4): illustrated the comparison between the achievement retention level of study and control group before and after the application of brain gym. It was that all the students in the study group improved from low to high achievement and retention level after the application of brain gym. While in the control group the students improved from low level for all of them to moderate level for about half of them and high level for one quarter of them after the application but their level was decreased in the retention level to become more than two thirds then return to low level again . There were statistically significant differences in achievement and retention tests between the study and control groups, as well as within the study group, before and after the use of brain gym in favor of the study group. (0.001).

Table (5): portrayed the relation between personal and academic characteristics and multiple intelligences of the study group after the application of brain gym. After using the brain gym, it was shown that there were no statistically significant differences in the study group.

Table (6): showed the relation between the personal and academic characteristics and achievement retention test of the study group after the application of brain gym. It was found that there were no statistically significant differences in the study group after the application of brain gym.

Table (1): Distribution of community health nursing students according to their personal and academic characteristics.

personal and academic characteristics	Group				MCP
	Study N=102		Control N=102		
	No	%	No	%	
Age (years)					
▪ 21	59	57.8%	59	57.8%	1.000
▪ 22	43	42.2%	43	42.2%	
Gender					
▪ Male	50	49.0%	49	48.0%	1.000
▪ Female	52	51.0%	53	52.0%	
GPA					
▪ C-	10	9.8%	11	10.8%	
▪ C	15	14.7%	14	13.7%	
▪ C+	10	9.8%	12	11.8%	- 0.938
▪ B-	15	14.7%	13	12.7%	
▪ B	22	21.6%	21	20.6%	
▪ B+	30	29.4%	31	30.4%	
English level					
▪ Poor	30	29.4.0%	31	30.4%	1.000
▪ Good	21	20.6%	19	18.6%	
▪ Very good	51	50.0%	52	51.0%	
Computer skills					
▪ Poor	16	15.7%	14	13.7%	0.533
▪ Good	56	54.9%	52	51.0%	
▪ Very good	30	29.4%	36	35.3%	

^{2}: **Chi square test** - p value for comparing between the two studied groups

*: Statistically significant at $p \leq 0.05$

Table (2): Comparison between the median of the study and control groups' students according to their multiple intelligences before and after the application of brain gym.

Multiple intelligences tool		Study group		Z (P)	Control group		Z (P)	Study/ Control	Study/ control
		Before	After		Before	After		Before ^{u}p	After ^{u}p
	Minimum	-10	-6		-10	-10			
Linguistic	Maximum	10	10	5.9 (0.001)*	9	9	0.09 (0.927)	0.121	
	Median	-1	6		1	2			0.001*
	Minimum	0	3		0	0			
Logical	Maximum	10	10	4.3 (0.001)*	10	9	0.02 (0.988)	0.256	
	Median	4	8		2	2			0.001*
	Minimum	-12	2		-12	-12		0.862	
Musical	Maximum	11	11	6.3 (0.001)*	11	11	0.42 (0.671)		
	Median	-2	7		-2	-1			0.001*
	Minimum	0	3		0	0			
Visual	Maximum	10	10	3.5 (0.001)*	9	9	0.05 (0.961)	0.664	
	Median	4	6		4	4			0.001*
	Minimum	0	4		0	0		0.628	
Kinesthetic	Maximum	10	10	5.7 (0.001)*	10	10	0.06 (0.952)		0.001*
	Median	3	7		2	2			
	Minimum	-7	2		-7	-7			
Interpersonal	Maximum	9	9	4.1 (0.001)*	9	9	0.08 (0.934)	0.946	
	Median	3	6		3	3			0.001*
	Minimum	0	1		0	0		0.680	
Intrapersonal	Maximum	13	15	2.7 (0.001)*	13	11	0.08 (0.938)		
	Median	5	6		4	4			0.001*
	Minimum	0	4		0	0			
Naturalistic	Maximum	7	10	6.4 (0.001)*	7	7	0.09 (0.929)	0.673	
	Median	2	7		2	2			0.001*
	Minimum	0	3		0	0			
Existential	Maximum	7	9	6.0 (0.001)*	7	7	0.06 (0.948)	0.944	
	Median	2	6		2	2			0.001*

Z: Wilcoxon test * P < 0.05 (significant) ^{U}P: Mann-Whitney test

Fig (1): Comparison between the median of the study group students according to their multiple intelligences before and after the application of brain gym.

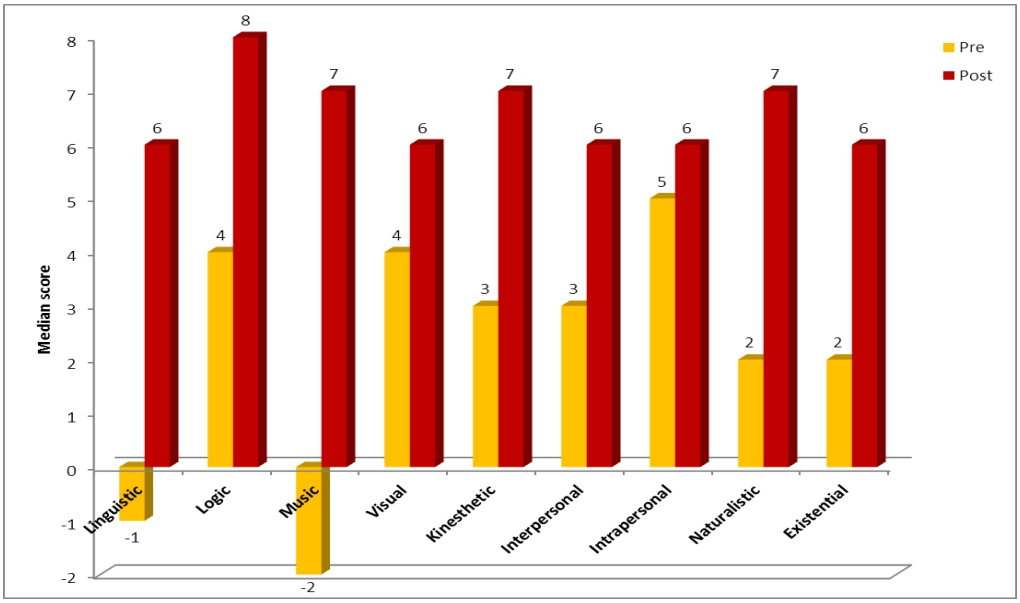

Fig (2): Comparison between the median of the control group students' according to their multiple intelligences before and after the application of brain gym.

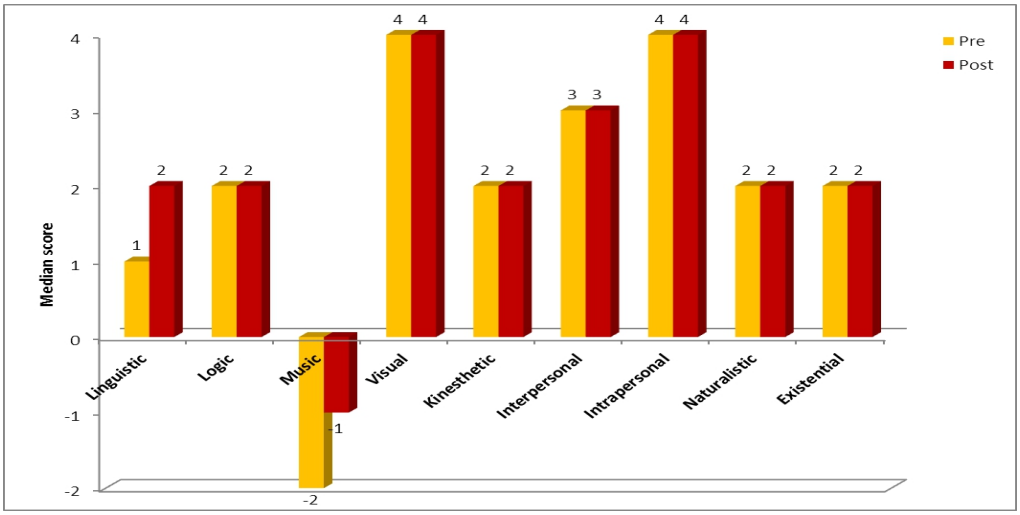

Table (3): Comparison between the mean and standard deviation of the study and control groups' according to their achievement retention test before and after the application of brain gym.

Achievement Retention Test	Study group			F (P)	Control group			F (P)	Study/ control Achievement Test	Study/ control Achievement Test	Study/ control Retention Test
	Achievement pre Test	Achievement Post Test I	Retention Post Test II		Achievement Pre Test	Achievement Post Test I	Retention Post Test II		pre Test UP	Post Test I UP	Post Test II UP
Minimum	0.0	19.0	17.0		0.0	5.0	4.0				
Maximum	3.0	20.0	20.0	12.8 (0.001)*	2.0	15.0	10.0	4.6 (0.057)	0.524	0.001*	0.001*
Mean	0.8	19.9	19.9		0.7	8.2	7.0				
SD	0.9	0.4	0.7		0.8	2.2	1.4				

F: repeated measures ANOVA * P < 0.05 (significant) UP: Mann-Whitney test * P < 0.05 (significant)

Table (4): Comparison between the achievement retention level of study and control group before and after the application of brain gym.

Achievement Retention Test	Study group							Control group						
	Achievement pre Test		Achievement Post Test I		Retention Post Test II		P	Achievement Pre Test		Achievement Post Test I		Retention Post Test II		P
	No	%	No	%	No	%		No	%	No	%	No	%	
Low	102.0	100 %	0.0	0.0 %	0.0	0.0 %		102.0	100.0 %	31.0	30.4 %	64.0	62.7 %	
Moderate	0.0	0.0 %	0.0	0.0 %	0.0	0.0 %	0.00 *	0.0	0.0%	46.0	45.1 %	32.0	31.4 %	0.615
High	0.0	0.0 %	102.0	100 %	102.0	100 %		0.0	0.0%	25.0	24.5 %	6.0	5.9 %	

T student t test * statistically significant at $p \leq 0.05$

Table (5): Relation between personal and academic characteristics and multiple intelligences of the study group after the application of brain gym.

personal and academic characteristics		Post Logic Median	Post Linguistic Median	Post Musical Median	Post Visual Median	Post Kinesthetic Median	Post Interpersonal Median	Post Intrapersonal Median	Post Naturalistic Median	Post Existential Median
Age	20	9.0	4.0	8.0	7.0	4.0	5.0	4.0	5.0	7.0
	21	7.0	6.0	7.0	6.0	6.0	6.0	7.0	6.0	7.5
	P1	0.111	0.393	0.624	0.629	0.375	0.432	0.562	0.604	0.958
Gender	Male	6.5	6.0	6.0	6.0	5.0	6.0	9.0	6.5	5.0
	Female	8.0	6.0	8.0	7.5	7.0	5.0	6.0	4.5	6.5
	P1	0.311	0.831	0.060	0.083	0.107	0.270	0.214	0.008	0.861
Residence	Urban	6.5	7.0	7.0	6.0	6.0	6.0	7.0	6.0	7.0
	University dorm	8.5	8.0	8.0	6.5	3.5	4.5	5.0	5.5	6.5
	P1	0.449	0.072	0.119	0.684	0.705	0.063	0.826	0.060	1.000
GPA	C-	6.5	5.5	7.0	6.0	5.5	6.0	8.0	8.0	5.5
	C	9.5	6.5	8.5	8.5	4.5	5.5	6.0	4.0	6.0
	C+	8.0	7.0	7.0	7.0	5.0	5.0	7.0	6.0	7.0
	B-	6.5	5.0	8.5	5.5	5.0	6.5	6.5	6.0	6.5
	B	7.0	6.0	7.0	7.0	7.0	6.0	6.0	5.0	7.5
	B+	7.5	6.0	6.0	5.0	6.5	5.0	8.5	7.0	6.5
	P2	0.522	0.444	0.606	0.608	0.718	0.613	0.400	0.127	0.617
English	Poor	3.0	3.5	8.0	6.0	4.0	7.0	6.0	6.0	4.0
	Good	7.5	5.0	7.5	4.5	5.5	6.0	7.0	6.0	7.0
	Very good	8.0	6.0	7.0	7.0	6.0	5.0	7.5	7.0	7.5
	P2	0.627	0.072	0.892	0.923	0.589	0.843	0.915	0.635	0.259
Computer	Poor	3.5	6.5	7.5	6.5	5.0	5.5	7.0	6.0	6.5
	Good	7.0	6.0	7.5	6.0	5.5	6.0	7.0	6.0	6.5
	Very good	8.0	9.0	8.0	7.5	6.5	5.5	7.5	6.5	7.0
	P2	0.679	0.106	0.799	0.495	0.526	0.580	0.880	0.750	0.366

Table (6): Relation between the personal and academic characteristics and achievement retention test of the study group before and after the application of brain gym.

personal and academic characteristics		Study group					
		Achievement Pre test		Achievement Post test		Retention Test	
		Mean	SD	Mean	SD	Mean	SD
Age	19	1.7	1.0	19.9	0.3	19.9	0.3
	20	0.6	0.8	19.8	0.4	19.5	0.7
	P	0.061		0.719		0.145	
Gender	Male	1.0	1.0	19.8	0.4	19.5	0.8
	Female	0.7	0.8	19.9	0.3	19.8	0.4
	P	0.239		0.389		0.161	
Residence	Urban	0.8	1.0	19.9	0.2	19.6	0.7
	University dorm	0.8	0.9	19.5	0.5	19.6	0.7
	P	0.803		0.041		0.908	
GPA	C-	0.6	0.7	19.9	0.4	19.5	0.5
	C	0.5	0.7	20.0	0.0	19.5	0.7
	C+	0.6	1.3	19.8	0.4	20.0	0.0
	B-	1.1	1.1	19.9	0.4	19.5	0.5
	B	0.9	0.9	19.8	0.4	19.5	1.0
	B+	0.8	1.0	19.8	0.5	19.8	0.5
	P+	0.879		0.980		0.802	
English	Poor	1.0	0.0	20.0	0.0	20.0	0.0
	Good	0.9	1.0	19.8	0.4	19.5	0.9
	Very good	0.8	0.9	19.9	0.3	19.7	0.5
	P+	0.902		0.516		0.631	
Computer	Poor	1.2	1.0	20.0	0.0	19.8	0.4
	Good	0.7	0.9	19.8	0.4	19.6	0.6
	Very good	0.9	1.1	20.0	0.0	19.4	1.0
	P+	0.547		0.099		0.451	

Discussion

Brain Gym's basic focus is to use physical activity to gain access to various sections of the brain. These types of movements can be used by teachers to assist their pupils with conduct, comprehension or retention, organization, executive function, and communication. Brain Gym improves neurological function by connecting and making parts of the brain more accessible for any given task. After using the brain gym, statistically significant differences were found between the study and control groups, as well as within the study group, in relation to all multiple intelligence types and the presence of massive elevation in the median scores of all intelligence types in the current study.

These results came in congruence with the study of **(Freeman & Chapman., 2006,John.,2016),** who claimed that using brain gym resulted in considerable improvements in students' various intelligences and academic performance, as well as an increase in the medians of all intelligences after utilizing it. Furthermore, (**Gilberto., 2007**) discovered that kids who conducted the brain gym activities for 20 minutes every day had higher reading and math intelligences than those who did not.

In a similar way, (**Piengkes & Wolther., 2008**) shown that the primary purpose of brain-based education is to assist students in the development of intellectual tools and different intelligences. Similarly, (**Hannaford., 2018**) found that after utilizing brain gym, all students improved their reading comprehension scores by one year, and several students improved their total academic growth intelligences by nearly two years. Brain gym improved students' attention, self-awareness, confidence in spelling, math, writing, musical, reading, interpersonal, intrapersonal, and naturalistic intelligences, according to (**McGovern., 2009**). Students became calmer, happier, and less moody as a result of the program.

In congruent with, **(McCandliss., 2010)** who performed a research using the brain computed tomography to determine changes in multiple intelligences areas in both sides of the brain after using brain gym. The result confirmed that, there were differences in the brain images between the students who used brain gym and those who do not, as these areas became wider and deeper after the application. **(Duman., 2011)** Students' multiple intelligences and academic achievement scores were greater when they were taught utilizing brain gym rather than traditional teaching approaches like lectures and question-answer sessions.

Moreover, **(Shaywitz & Audey., 2011)** who concluded that, brain gym provided students with many opportunities for hands-on activities, collaboration with other students, enriched their learning and provided them with real life activities. Also it improved all their multiple intelligences skills which modified them from a person not aware of their intelligence capability to an intelligent person with varying degrees in the nine intelligence types.

In addition, The effect of brain gym on boosting certain intelligences was studied by **(Carol., 2012)** using an electroencephalograph (EEG). He found that it improved students' spatial and language brain centers and helped them to get greater retention of the words that incorporated both hemispheres. Moreover, **(Tilton., 2013)** found that using brain gym movements improved students' success in the logical, mathematical, visual and kinesthetic intelligences. Whereas, **(Klink., 2013)** concealed that

using brain gym in a socially isolated students, improved their interpersonal, intrapersonal, naturalistic and existential intelligences. These improvements were due to developing different brain networks which changed the brain processes underlying them.

In the current study, statistically significant difference in achievement and retention assessments were identified between the study and control groups, as well as within the study group, after the application of brain gym.. Also all the students are converted from low achievement before the application to high achievement and retention level after the application. These results came in congruent with the study of **(Ozeden & gultleen., 2014)** who studied the impact of using brain gym on the students' achievement and retention of information. The results showed that, brain gym had a positive impact on students' achievement and information retention.

In addition, **(Demirel., 2015)** determined that after the application of brain gym, the study group students' got higher achievement test score than the control group. This result is sustained by **(Kiedinger., 2015 ,jeffer.,2019)** who also examined the influence of brain gym on the retention test score after three weeks from ending the course of critical care nursing and found that students remained at the same level of achievement's score posttest, which meant that the student had a high information retention level compared to the achievement test.

Moreover, **(McNamee., 2016)** found that there was a positive correlation between the brain gym application and students' achievement and the retention levels improvement. The student level modified from low level in the pretest to high level in the achievement posttest and slightly decreased in the retention test than in the achievement posttest. These results supported by **(Stephen., 2016, Westor.,2019)** who conducted a study to find out the effectiveness of brain gym in scientific understanding achievement test which revealed that students got a higher score in the posttest than the pretest with a highly statistically significant difference. This is to some extent similar to, **(Duman's., 2017, Mick.,2020)** findings whose study aimed to recognize the impact of using brain gym on the achievement and retention of students with different patterns of learning. The results indicated that; brain gym helped in improving the achievement and retention scores through improving the learning pattern of the students.

In the same way, **(Gözüyeşil & Dikici., 2017)** determined the effect of brain gym on students' motivation and achievement retention. The results revealed that the students got in a vicious circle as after using brain gym, they became motivated to study and learn so they got a high scores in the achievement and retention tests .Also after they got a higher score, they became highly motivated to study and learn . Furthermore, **(William, 2018)** concluded that there was a positive impact of brain gym program on students' academic achievement and retention, as they got a high score in achievement test and after one month the retention test decreased only from 0.5 to 1 grade. This result was in harmony with **(Cengelci., 2019)** who revealed that the brain gym approach appeared to be more effective than the traditional teaching methods in enhancing the retention of the gained knowledge.

The researcher viewed the improvement of multiple intelligences and achievement retention test at the end

product of brain gym application was due to the central effect of the three categories of brain gym which work on reunion of both brain hemispheres, improve neural pathway between brain cells and develop more relaxed technique against study stress. This leads to improving the abilities of both hemispheres, increasing attention, concentration, memory and achievement abilities and develop advanced relaxation techniques. Also students became more motivated to learn and study in their homes after each session which decreased the load of study for achievement test and retained information test after three weeks of cessation of sessions.

Conclusion

From the findings of the present study, it can be concluded that:

The current study investigated the Effect of brain gym technique on community health nursing students' multiple intelligence, knowledge and information retention and discovered the relationship of that effect with students' characteristics. The current study findings concluded that community nursing students who were subjected to brain gym technique had better multiple intelligences, knowledge and retention score than those of the control group. Accordingly, the current study has proved the effectiveness of integrating brain gym technique with traditional learning in enhancing students' knowledge acquisition as well as knowledge retention maintenance.

Recommendations:

Based on the current study findings, it can be recommended that brain gym technique should be incorporated in nursing theory and clinical education to improve the level of students' knowledge and retention. Also a practical workshop for measuring the multiple intelligences score for teachers and students and train them on the brain gym to enhance their thinking skills whereas these skills are highly correlated to students' theoretical and practical levels and to prepare them as future competent nurses.

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