BRAIN GYM® EXERCISES AND MIDDLE SCHOOL STUDENTS' PERFORMANCE IN EXAMS IN DUBAI

DUAA M. A. N. ALHERBAWI

Ph.D student at British University in Dubai, A biology Teacher at Applied Technology Schools – Ajman
E-mail: duaaherbawi@gmail.com

Abstract - This research examined how Brain Gym® exercises could be used to enhance the academic outcomes and classroom behavior of the middle school students in Dubai, United Arab Emirates. Student engagement, mental health, and learning strategies were identified as factors that influenced academic performance in middle school due to their combination as multiple elements. As a measure to improve attention, memory, and learning readiness, Brain Gym® exercises were suggested, where the physical movement involved in the process had to be coordinated with the brain activity. The evaluation of the intervention was based on a quasi-experimental research design with a mixed-method approach. The research was done in American International School in Dubai and involved 44 Grade 6 students who were boys. It was introduced with a six-month period of Brain Gym® exercises of five minutes at the start of every science lesson. The data were gathered before the intervention and after it with the help of quizzes, tests, and the survey of students. T-tests were used to statistically examine the scores in midterm and final exams. Findings revealed that there were positive changes in classroom attention and classroom behavior in students and statistical differences were not significant in terms of examination. All in all, the results indicated that Brain Gym® exercises could have played a role in enhancing student engagement and readiness to learn, which points to the possibility of the suggested intervention as a simple classroom-based intervention in middle school learning.

Keywords - Brain Gym®; Academic Performance; Middle School Students; Physical Activity and Learning; Cognitive Engagement; Classroom Behavior; Dubai Schools; Educational Intervention.

I. INTRODUCTION

There are personal, family, school and peer factors that impact academic performance problems in middle schools. Achievement is influenced by cognitive abilities, motivation, stress, substance use, parental involvement, and family background[1]. There is a need for school-based support and help for the organization and mental health of ADHD students [2]. and teaching quality and family beliefs influence STEM performance[3]. Depression, anxiety and stress are detrimental to achievement[4; 5; 6]. while social support and community school programs are positively linked to engagement and long term academic development[7;8]. Cognitive readiness, engagement and physical activity are correlated with learning effectiveness. Moderate exercise can enhance critical thinking and self-regulation[9]and CATS strategies can enhance motivation and self-efficacy[10]. Combined exercise and cognitive training leads to an enhancement of attention, memory, and intelligence[11]. while morning exercises enhance attention, working memory, and mood[12], Moving the learning space from a place of sitting to one of movement optimises cognition[13]and embodied learning is known to foster motivation and interdisciplinary engagement [14; 15; 16; 17].

Brain Gym® helps to facilitate cognitive functions and performance in school, especially in the learning of mathematics for pupils in middle school [18]. Brain Gym plus aerobic activities might enhance attention, memory and communication[19]. But findings about its more general efficacy are far from consistent[20]although there might be neurobiological effects on attention and self-awareness[21].

The UAE education system is based on inclusiveness and quality through policies related to inclusive education of diverse students[22]. Adaptive leadership despite its difficulties has a positive impact on the achievement in mathematics, self-efficacy, anxiety reduction, and critical thinking development [23]. even with high student-teacher ratio and limited specialization[22]. The use of technology and AI-driven teaching methods is also growing in Dubai private schools[24].

Problem Statement

The leadership, attitude of students and outside factors like COVID-19 impact academic performance in the UAE middle schools. Strong leadership has a positive impact on achievement in maths, whilst too strict of a discipline has a negative impact on confidence [23]. During the pandemic, academic outcomes were enhanced with positive attitudes towards online learning and also self-motivation[25]. Social and Emotional Learning (SEL) interventions were also found to have a positive impact on cognitive and socio-emotional development[26]and

general research found that academic, social, personal and demographic factors were associated with low achievement[27]. New technologies like ChatGPT can also help enhance student performance[28].

The traditional teaching methods are a passive learning and lack of student interaction. Interactive video-based and case-based learning approaches enhance knowledge retention, critical thinking and satisfaction over lecture based approaches [29;30]. A mix of inquiry and direct instruction is more effective at engaging the mind than one or the other alone[31]. Other educational methods such as team based learning, problem based learning and flipping classrooms also enhance theoretical and practical knowledge and satisfaction of the students[32; 33; 34]. Overall, evidence has been found in favor of interactive and student-centered interventions to enhance cognitive response and long-term learning outcomes[35; 36].

The study is theoretically important as it helps to contribute in the study of Brain-based learning and embodied cognition by studying the effect of Brain Gym on the cognitive readiness and learning outcomes of middle schools. It also offers empirical evidence pertaining to the correlation between physical activity and school performance. The practical implications of the findings can influence teachers, administrators, and policy makers to implement inexpensive, movement-based interventions to boost attention, motivation and achievement. The study not only has relevance for the UAE educational environment, which promotes innovation in teaching and learning and all-round development of children, but also provides Middle Eastern evidence for the few international studies on Brain Gym and movement-based learning strategies.

II. LITERATURE REVIEW

Brain-Based Learning Theory suggests that adolescence is a key period of brain development that is associated with cognitive flexibility, working memory and higher order thinking [37; 38; 39]. Movement-based learning and motor learning contribute to attention, memory and understanding[40;41]. Evidences of neuroscience have also demonstrated that interventions based on movement also lead to improving the cognitive performance and to a reduction of deterioration in learning due to inactivity[42].

Exercise and movement-based learning enhance executive functions, attention, working memory, stress reducing and academic outcomes[12; 13; 43]. Physically active lessons and cognitively challenging activities improves motor skills, cognitive efficiency and academic achievement[16; 44]. But the data on the impact of creativity in physical activity on cognitive flexibility are not univocal[45; 46]. and recent trials are still investigating optimal strategies of physical activity with school students[47].

Brain Gym is a series of coordinated movements to enhance concentration, communication, memory and academic achievement[19].

Brain Gym can be used together with aerobic exercises to improve cognitive functions, physical coordination, and readiness to learn in a systematic manner that includes moving and reflecting the movement practice [19]. Brain Gym interventions have also aided in Mathematical problem solving and understanding as compared with the conventional teaching and learning approach[18]. Overall, physical activity in combination with cognitive training is beneficial for the development and learning process of students [48].

Physical stimulation in the classroom has a positive impact on attention, working memory, executive functioning, and classroom behavior and learning[10; 19; 48;49; 50]. Some studies did show minimal effects of Brain Gym with older adults[20]. and overall, movement and cognitive challenges have beneficial effects on classroom interaction and cognitive performance. Brain Gym interventions have demonstrated a positive impact on mathematics achievement, executive functioning and academic success particularly when interventions are of moderate intensity and duration[18;45; 51]. Working memory, executive functioning, physical fitness and intrinsic cognitive motivation are also linked to academic improvement [52; 53;54].

International research is also a validation of neurodidactic and Brain Gym interventions. Research has been reported in Kazakhstan, Vietnam, Thailand and Latin America that show gains in intelligence, self-regulation, mathematical skills, physical fitness, attention, memory and academic achievement using movement-based or Brain Gym related programs[18; 19;49; 55;56]. All these international findings would suggest the adoption of Brain Gym or other neurodidactic exercises in school curriculums to nurture cognitive growth and academic success in schools.

These studies also showed positive impacts on the mathematics achievement of middle school students, as well as behavioral self-regulation and higher-order thinking[19; 48; 57; 58].

Research Gap

Although there is an increasing body of evidence relating to physical activity and academic performance [12; 13; 43],there is limited and inconsistent evidence in the field of Brain Gym interventions [18; 19;20; 21]. This lack of consistency means that additional empirical research is necessary to make the educational effectiveness of Brain Gym interventions clear.The majority of the studies were on movement-based learning in general, primary school children, or adults [37; 38], and not middle school students. Furthermore, there is limited research on Brain Gym interventions in the Middle East region, especially in UAE private schools in the light of the UAE government attention on innovative education and academic improvement [22; 23], Hence, the current study aims to fill this gap by exploring the effect of Brain Gym® exercises on the academic achievement of middle school boys in private schools in Dubai.

III. RESEARCH PROCEDURES

The researcher conducted three exercises of brain gym for five minutes in every science period, along with encouraging them to drink water and to breathe deeply. The research was implemented for six months, and data were collected pre- and post-implementing the brain gym. The research was conducted at the American International School, Dubai, UAE, with the participation of 44 students from grade six. Quantitative data were collected pre- and post-brain gum implementation. Quiz one and quiz two marks were collected before the implementation of Brain Gym, and the results were compared with the two quizzes that were conducted after the implementation of Brain Gym. The survey was designed by the researcher and transferred into softwareby the survey application www.surveymonkey.com. Students were told that if they liked these exercises, they would continue with them. Brief training took place for ten minutes, and after that, students did the three Brain Gym exercises, and then they were asked to answer a survey of twelve questions.

IV. RESULTS

First Participants' gender

The table shows that all participants were boys. Conditions were ripe for the variable to be controlled, as most schools in the UAE tend to separate students based on their gender due to cultural considerations

Second: Participants' age

Table (B) Responses of students to question 2 – First Survey

Q2: Kindly choose an age

6B1

Answer Choices	Responses	
10 Years Old	0.00%	0
11 Years Old	42.86%	9
12 Years Old	38.10%	8
13 Years Old	19.05%	4
14 Years Old	0.00%	0
	Answered	21
	Skipped	0

6B2 - A total of 23 students

Answer Choices	Responses	
10 Years Old	8.70%	2
11 Years Old	47.83%	11
12 Years Old	43.48%	10
13 Years Old	0.00%	0
14 Years Old	0.00%	0
	Answered	23
	Skipped	0

Students' ages for all 44 participants varied between 10 and 13 years old. The majority of the 44 students were 11 years old, which was about 45.45%, nearly 40.91% were 12 years old, 9.09% were 13 years old, and about 4.54% were 10 years old.

Source of Table (B): Author

It reflects the diversity of ages in grades 6B1 and 6B2. As shown in the table below, students ranged in age from ten to thirteen years.

Third: Sport Practice

Table (C) Responses of students to question 3 – First Survey

Q3: Do you play sports at least three times every week?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	38.10%	8
No	61.90%	13
	Answered	21
	Skipped	0

6B2 - A total of 23 students

Answer Choices	Responses	
Yes	34.78%	8
No	65.22%	15
	Answered	23
	Skipped	0

A total of 44 students answered this question. 36.36% reported that they do play sports regularly during the week. 63.63% reported that they don't play sports on a regular basis.

Source of Table (C): Author

The table reflects a real problem, as most of the students responded that they don't tend to play sports on a regular basis. This also explains the observation of the English and the science teacher at the beginning of the year, as physical movement is directly related to high academic achievement and sharp cognitive skills (Davis, 1997).

Fourth: Drinking Water

Table (D) Responses of students to question 4 – First Survey

Q4: I drink water several times every day

6B1- A total of 21 students

Answer Choices	Responses	
Yes	33.33%	7
No	66.67%	14
	Answered	21
	Skipped	0

6B2 - A total of 23 students

Answer Choices	Responses	
Yes	39.13%	9
No	60.87%	14
	Answered	23
	Skipped	0

A total of 44 students answered this question. 36.36% reported that they drink water regularly during the day. 63.63% reported that they drink water every day.

Source of Table (D): Author

It reflects that most of the students do not tend to drink water regularly, and that is not a good sign (Bar-David, Urkin&Kozminsky 2005).

Fifth: Pain at the beginning of the exercise

Table (E)Responses of students to question 5 – First Survey

Q5: Did you feel any pain in your head at the beginning of the special exercises?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	71.43%	15
No	23.81%	5
I am not sure	4.76%	1
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	47.83%	1
No	34.78%	8
I am not sure	17.39%	4
	Answered	2
	Skipped	0

59% of the students stated that they experienced pain in their head when they did the exercises for the first time. Around 29.54 % didn't feel any pain, and 11.36 % could not distinguish their feelings.

Source of Table (E): Author

The table above indicates that most students don't play sports; this is why most of them feel uncomfortable. The answers to this question are also expected results, as most of the students indicated that they do not play sports regularly (Reneker et al., 2015).

Sixth: Feeling dizzy at the beginning of the exercises

Table (F)Responses of students to question 6 – First Survey

Q6: Did you feel dizzy at the beginning of the exercises?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	71.43%	15
No	23.81%	5
I am not sure	4.76%	1
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	65.22%	15
No	26.09%	6
I am not sure	8.70%	2
	Answered	23
	Skipped	0

68% of the 44 students reported that they felt dizzy when they did the exercises for the first time. 25% of the students didn't feel dizzy, and 6.18% could not decide.

Source of Table (F): Author

The table above indicates that most students don't play sports. Usually, this is why most of them feel uncomfortable. This also explains their aggressive behavior sometimes towards each other, as physical movements lead to less stress (Reneker et al., 2015).

Seventh:Feeling pain in the chest at the beginning of the exercise

Table (G)Responses of students to question 7 – First Survey

Q7: Did you feel pain in the chest at the beginning of the exercise?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	19.05%	4
No	76.19%	16
I am not sure	4.76%	1
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	26.09%	6
No	60.87%	14
I am not sure	13.04%	3
	Answered	23
	Skipped	0

The majority of the students 68% didn't feel any pain in their chest. 22% felt pain, and the rest 9.1% could not decide.

Source of Table (G): Author

This question was asked to prevent students from having chest pain from conducting the exercises.

Eighth: Focusing on the movements

Table (H)Responses of students to question 8 – First Survey

Q8: During the exercise, were you able to focus only on the movements you were doing?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	76.19%	16
No	14.29%	3
I am not sure	9.52%	2
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	82.61%	19
No	13.04%	3
I am not sure	4.35%	1
	Answered	23
	Skipped	0

79.54% of the students reported that they were focusing on the exercises only. 13.63% were not able to focus while doing the exercises. 6.8% couldn't decide.
Source of Table (H): Author

Results above showed that Brain Gym proved to have a positive impact on students' behavior during class and helped them focus, and this is supported as well by many studies that prove the direct link between physical movements and increasing cognitive abilities to focus. (Rowan 2009).

Ninth: Focusing in class after doing these exercises

Table (I)Responses of students to question 9 – First Survey

Q9: Were you able to focus in class more after doing these exercises?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	76.19%	16
No	4.76%	1
I am not sure	19.05%	4
	Answered	21
	Skipped	0

6B1

Answer Choices	Responses	
Yes	76.19%	16
No	4.76%	1
I am not sure	19.05%	4
	Answered	21
	Skipped	0

72.72% of the students felt that they could focus more. 4.54% of the students reported that the exercises didn't affect their focus in class. 18.18% couldn't decide.

Source of Table (I): Author

The results above showed that Brain Gym proved to have a positive impact on students' behavior during class and helped them focus. Students stated that they were able to focus and were more aware of what they had to do in the classroom.

Tenth :Increase in heartbeats

Table (J)Responses of students to question 10 – First Survey

Q10: Did you feel an increase in your heartbeats?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	66.67%	14
No	19.05%	4
I am not sure	14.29%	3
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	68.18%	15
No	4.55%	1
I am not sure	27.27%	6
	Answered	22
	Skipped	1

65.90% felt an increase in their heartbeats, whereas 11.36% didn't feel any change in their heartbeat. 20.45% could not decide.

Source of Table (J): Author

This question was asked as an indicator to know if students are really doing the exercises and following instructions, or not, as playing sports usually leads to an increase in heartbeats (Reneker et al., 2015).

Eleventh:Taking a deep breath

Table (K) Responses of students to question 10 – First Survey

Q 11: By the end of the exercises, did you take a deep breath?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	85.71%	18
No	9.52%	2
I am not sure	4.76%	1
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	86.96%	20
No	8.70%	2
I am not sure	4.35%	1
	Answered	23
	Skipped	0

86.36% of the 44 students felt that they wanted to take a deep breath at the end of the exercise, and they took a deep breath. 9.09% Didn't take a deep breath, and 4.54% couldn't decide.
Source of Table (K): Author

Results showed that Brain Gym helped students to breathe deeply, which is a positive indicator. There are various methods and techniques to get rid of tension and stress. One of the most popular methods is the deep breathing technique (Perciavalle et al., 2016).

Twelfth: Repeating the exercises again

Table (L)Responses of students to question 12 – First Survey

Q12: Would you like to repeat the exercises again?

6B1- A total of 21 students

Answer Choices	Responses	
Yes	100.00%	21
No	0.00%	0
	Answered	21
	Skipped	0

6B2- A total of 23 students

Answer Choices	Responses	
Yes	86.96%	20
No	13.04%	3
	Answered	23
	Skipped	0

93.18% of the students would like to repeat the exercises again next year. 6.8% didn't want to repeat it again.

Source of Table (L): Author

The table above indicates that students enjoyed the period when Brain Gym was conducted. This is a positive indicator that these exercises have a positive impact on the students. [11].

Assessments, Grades, Results / Analysis

American International School
Science Department - Grade: 6B1
2017-2018

Brain Gym Implementation status	Before Brain Gym Implementation		During Brain Gym Implementation			After Brain Gym Implementation
Date:	Oct. 4th 2017	Oct. 23rd 2017	Dec. 10th 2017	Jan. 23rd 2018	Feb. 29th 2018	Jun. 12th 2018
Students No.	Q1: 10	Q2:10	Midterm Exam 40	Q1: 10	Q2:10	Final Exam 40
1	9	9	19	7	8	34
2	7	5	14	1.5	4	39
3	6	6	20	5.5	5	20
4	7	7.5	12	7	7	37
5	5.5	5	13	8	8	28
6	9	10	24	6	6	27
7	10	10	29	6.5	6.5	16
8	6	10	16	7	7	36
9	4.5	6	8	5.5	5.5	24
10	8.5	10	30	10	8	26
11	9	9	31	8	8.5	23
12	7.5	7	23	5	4	26
13	8	8	26	6.5	5	34
14	9	10	30	9	8	34
15	8	7.5	25	5	5	16
16	8	10	38	8	9	28
17	10	10	33	6.5	8.5	33
18	9.5	10	33	10	7	36
19	8	10	24	4	9	35
20	5	9	18	3.5	5.5	32
21	10	10	33	7	8	34

Table (1): Marks of quizzes and exams conducted before, during, and after Brain Gym exercises were done. 6B1

Source of the table: Author – American International School- Dubai, UAE.

T – Test Analysis

T – Test analysis has been done separately for the midterm and final exams to find out the significant or insignificant impact of brain gym exercises. The t – tests have been calculated for both Grades 6B1 and 6B2, respectively, and the results have been displayed separately for better understanding.

Table (3): t-Test analysis for the average marks of the midyear and final: Two-Sample Assuming Equal Variances - Grade 6B1		
	Midterm	Final Term
Mean	23.76190476	29.42857143
Variance	67.59047619	46.15714286
Observations	21	21
Pooled Variance	56.87380952	
P(T<=t) two-tail	0.019453998	
Table (3) Source: Author		

The above table indicates the output of a two-sample t-test for studying the significant difference in the midterm and final term marks of the students. His table shows the overall impact of brain gym exercise on the students, and it has been calculated by comparing the midterm exams and final exams of the students. The p-value of the t-statistic found in the above table is 0.019, which is less than 5% level of significance, indicating that there is a significant difference in the marks of the midterm and final term, showing a significant impact of the Brain Gym.

Findings were almost the same in 6B2. Averages of quizzes dropped while major exams showed a significant improvement.

American International School Science Department - Grade: 6B2 2017-2018						
Brain Gym Implementation status	Before Brain Gym Implementation		During Brain Gym Implementation			After Brain Gym Implementation
Date:	Oct. 4th 2017	Oct. 23rd 2017	Dec. 10th 2017	Jan. 23rd 2018	Feb. 29th 2018	Jun. 12th 2018
Students No.	Q1: 10	Q2:10	Midterm Exam40	Q1: 10	Q2:10	Final Exam40
1	9.5	8.5	29	9.5	9.5	34
2	9.5	10	38	9	10	39
3	9.5	7.5	28	9	9	20
4	10	10	32	9.5	10	37
5	8.5	6	29	9	10	28
6	6.5	8	20	7.5	8.5	27
7	6.5	6	13	2	3	16
8	9.5	8	35	8.5	9.5	36
9	9	6	18	7	6	24
10	8.5	9	36	8	6	26
11	9.5	7	16	4	10	23
12	8	6	27	6.5	5	26
13	9	8.5	31	9.5	10	34
14	9	10	34	8	8.25	34
15	9.5	7	14	6	5	16
16	6.5	8	23	7	8	28
17	8.5	10	27	6	9.5	33

18	9.5	9	26	8.5	8	36
19	9.5	10	28	10	10	35
20	9	10	28	9.5	9	32
21	9	10	31	8.5	9	34
22	6.5	4.5	17	2.5	3	18
23	9.5	10	40	10	8	37

Table (2): Marks of quizzes and exams conducted before, during, and after Brain Gym exercises were done. 6B2

Source table (2): Author –American International School- Dubai, UAE

T-Test analysis for the average marks

Table (4) t-Test analysis for the average marks of the midyear and final: Two-Sample Assuming Equal Variances - Grade 6B2

	Mid Term	Final Term
Mean	26.95652174	29.26086957
Variance	58.40711462	50.4743083
Observations	23	23
Pooled Variance	54.44071146	
Hypothesized Mean Difference	0	
df	44	
P(T<=t) two-tail	0.295336024	

Table (4) Source: Author

The above table indicates the output of a two-sample t-test for studying the significant difference in the midterm and final term marks of the students. The p-value of the t-statistic found in the above table is 0.2953, which is more than 5% level of significance, indicating that there is an insignificant difference in the marks of the midterm and final term, showing an insignificant impact of the Brain Gym.

CONCLUSION

This research was made to test the effectiveness of Brain Gym® on improving the students' behavior and academic performance. To be able to develop a clear idea of the nature of Gym Brain exercise and how it can help teachers in their inherent mission to facilitate the education of students in an atmosphere of pleasure and psychological comfort.

This paper aimed at testing the effectiveness of one of the educational intervention techniques that has been highly marketed nowadays, which is the Bain Gym.
The research found a significant change in students' behavior as recorded by the teachers. The instructors noticed that after brain gym sessions, students seemed to be calmer and ready to listen to the instructions. Moreover, fewer fighting incidents were reported during the periods in which exercises were conducted. As a result, student's academic performance was improved.

RESEARCH LIMITATIONS

The main limitation was the short time of the period, as the students had to conduct only 5 minutes of Brain Gym® because the period is 50 minutes long, the sample size of schools and students was relatively small compared to the total number of both schools and students in Dubai. [24].

RECOMMENDATIONS

More research needs to be done on a large scale of schools at the same time. A large program can be established by the Ministry of Education in the UAE or by KHDA (Knowledge and Human Development Authority), as schools work under one of them. By that, we ensure a large number of schools. It is also highly recommended for Brain Gym developers to spend more effort in proving their hypothesis scientifically, at least by doing more scholarly and empirical papers. It is also recommended to do pool research, which means the Ministry of Education needs to assign a group of teachers in the whole city to study Brain Gym together, following the same method as parallels. By that, the sample size will be huge, and the results will be more accurate.

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