EFFECT OF A BRAIN-BASED LEARNING PROGRAM ON WORKING MEMORY AND ACADEMIC MOTIVATION AMONG TENTH GRADE OMANIS STUDENTS

Abstract: This study aims to investigate the effect of a brain-based learning program on working memory and academic motivation among tenth grade Omanis students. The sample was selected from students in the tenth grade in basic education in the Sultanate of Oman. The participants in this study were 75 preparatory school students. Experimental group (EG) consisted of 37 students while the control group (CG) consisted of 38 students. An experimental Pretest and Posttest Control-Group design was used in this study. The brain-based learning program was conducted to the whole class by their actual teacher during the actual lesson period for 8 weeks with 50 minute sessions conducted three times a week. The program was designed based on the three basic fundamentals of brain-based learning, namely 'orchestrated immersion', 'relaxed alertness', and 'active processing'. The results of this study indicated great gains for students in the experimental group in both working memory and academic motivation. This study goes some way to understanding working memory and academic motivation in Omanis tenth grade primary students.The study shows that students in the experimental group, compared to those in the control group, develop robust working memory and academic motivation due to training in brain-based learning. The study shows that those young students have great chance of developing their g memory and academic motivation.

Keywords: brain-based learning, working memory, academic motivation, tenth grade Omanis students.

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INTRODUCTION

Teaching as a system is supposed to be an interpersonal interaction between teacher, learner and learning environment. In today's educational context the teaching and learning process is not simple as learners are exposed to wide experiences and opportunities. There is a rapid shift from teacher- centered teaching to student centered approach. Brain based learning is regarded as a student-centered approach. It confirms that the learning of the individual is more effective and lasting. As a learning approach, brain-based learning is based on the structure and function of the human brain. In this type of learning, a teacher facilitates approach that utilizes learner's cognitive endowments as it is based on brain-based learning principles (Thomas and Swamy, 2014). Each learner is seen to have a huge potential and should be given the opportunity to learn in an optimum environment (Salmiza, 2012). Caine and Caine (2002) define brain-based learning as "recognition of the brain's codes for a meaningful learning and adjusting the teaching process in relation to those codes." Brain-based learning ameliorates students' learning through challenge and inherited by threats, it provides challenging, but not impossible tasks to encourage them to strive. Non-threatening learning environment stimulates learning experiences depending on working in pairs or groups, reflecting on ideas, thinking creatively through using a variety of resources (Ashraf Atta, 2017). As Jensen (2000) put it "we are placed in transformation phase", a transformation which changes many things such as start time of schools, disciplinary policies, assessment methods, teaching strategies, budget priorities, classroom environments, technology application and even the way we think about art and education (Afsar, Soghra and Hamideh, 2015).

STATEMENT OF THE PROBLEM

Educators face the problem of creating a brain-friendly classroom where all students are engaged and active. Though overwhelming amount of considerations have emerged from current brain research, not all educators all over the world in general, and in our Arab world in particular , are aware of the findings of these studies. In such a case, an unbalanced prospect for teachers to provide maximal learning opportunities for all students prevails and is created. Accordingly, there will be an urgent need to create positive emotional connections to learning so that long-term learning can be transferred easily and successfully to the real-world. If students feel unsafe, stressed, or are experiencing a low-cycle of brain activity, learning becomes impossible and they may hate the learning process as a whole and drop out. Conventional methods might be problematic and no longer is beneficial to students. Students, as Sousa (2006) claims, on average, retain only five percent of information delivered through lecture twenty-four hours later. Teachers try to do the teaching without considering whether the learners are motivated or not. Hence, employing methods that are more brain-friendly may be a way to increase the effectiveness of teaching and learning.

Further research is necessary to build on the vast amount of research into brain-based learning specially with Omanis students. This will allow researchers to determine how brain-based learning can be best used as an intervention with those students as there is a dearth of research with this population. Thus, the present study addresses the following questions.

1. Are there differences in post-test scores mean between control and experimental groups on Working Memory Test?
2. Are there differences in post-test scores mean between control and experimental groups on Academic Motivation Test?
3. Are there differences in pre- post-test scores mean of the experimental group on Working Memory Test?
4. Are there differences in pre- post-test scores mean of the experimental group on Academic Motivation Test?

PURPOSE OF THE STUDY

This study aims to investigate the effect of a brain-based learning program on working memory and academic motivation among tenth grade Omanis students. By gaining a better understanding of this process, teachers can apply the findings to create safe, stress-free classrooms that will engage the minds of students, improving their working memory, and that will help to ameliorate their academic motivation.

LITERATURE REVIEW

BRAIN-BASED LEARNING

Brain based learning theory becomes more evident specially in the publication of research-based strategies that educators use in these days. This kind of learning This kind of learning allows teachers to identity a particular theory that they can use to underlie their teachings in the classroom. Caine & Caine (1994) developed their 12 principles for brain-based learning in 1989 and recommend the following 12 principles for brain-based learning. These principles allow educators to reach a more diverse set of learners, affirming the notion that not all students learn the same way and allowing educators to teach in a multitude of ways (Connell, 2009):

1. The brain is a parallel processor: The brain performs many tasks simultaneously, including thinking and feeling.
2. Learning engages the entire physiology: The brain and the body are engaged in learning.
3. The search for meaning is innate: "[T]he brain's/mind's search for meaning is very personal. The greater the extent to which what we learn is tied to personal, meaningful experiences, the greater and deeper our learning will be" (Caine and Caine 1994, 96).
4. The search for meaning occurs through patterning: "The brain is designed to perceive and generate patterns, and it resists having meaningless patterns imposed on it" (Caine and Caine 1994, 88).
5. Emotions are critical to patterning: Our emotions are brain based; they play an important role in making decisions.
6. The brain processes parts and wholes simultaneously: The left and the right hemisphere have different functions, but they are designed to work together.
7. Learning involves both focused attention and peripheral perception: People hold general perceptions of the environment and pay selective attention to various parts of it.
8. Learning always involves conscious and unconscious processes: There is interplay between our conscious and our unconscious. "One primary task of educators is to help students take charge of their conscious and unconscious processing" (Caine and Caine 1994, 157).
9. We have at least two different types of memory: spatial (autobiographical) and rote learning (taxon memory). The taxon or rote memory systems consist of "facts and skills that are stored by practice and rehearsal" (Caine and Caine 1994, 169). Spatial, or autobiographical, memory "builds relationships among facts, events, and experiences" (Caine and Caine 1994, 170).
10. Learning is developmental: Children, and their brains, benefit from enriched home and school environments.
11. Learning is enhanced by challenge and inhibited by threat: Students optimally benefit when their assignments are challenging and the classroom environment feels safe and supportive. The brain learns optimally -- makes maximum connections --when appropriately challenged. But the brain "downshifts"–becomes less flexible and reverts to primitive attitudes and procedures -- under perceived threat.
12. Every brain is unique: This looks at learning styles and unique ways of patterning. We have many things in common, but we also are very, very different. We need to understand how we learn and how we perceive the world and to know that men and women see the world differently.

Caine & Caine (1994) claimed that great teaching involves three fundamental elements:

Relaxed alertness: Creating the optimal emotional climate for learning;
Orchestrated immersion in complex experience: Creating optimal opportunities for learning; and
Active processing of experience: Creating optimal ways to consolidate learning (p. 4-6).

WORKING MEMORY AND BRAIN-BASED LEARNING

Every day, the brain faces an overwhelming amount of input. The function of the brain at this time is to scan quickly for the useful information and tries move it from the sensory register to the short-term memory (SMT), or what is called working memory (WM) by focusing more specific attention on it (Gaddes & Edgell, 1994). Working memory, by its role, as Levine (2000) claims works as a storage area to compare and combine a new memory with old memories. Its primary purpose is: (1) to purge or release the new information from memory; (2) to maintain the information in working memory via simple rehearsal; or (3) to move (encode) the information from working memory into long-term memory for later recall (Banikowski and Mehring,1999).The learners are exposed to new input, and then their brains try to find some associations that are already established. In case of having some previous knowledge or experience about this new learned input, it is much more likely for the learners to remember it. When the working memory is active, it performs different tasks that are very important for success in school. Research on brain-based learning has provided evidence that working memory training improves test results (St. Clair-Thompson, Stevens, Hunt, and Bolder, 2010), and other broad varieties of academic skills (Melby-Lervåg and Hulme, 2013), for instance problem solving skills (Cheshire, Ball and Lewis, 2005; Jaeggi, Buschkuehl, Jonides and Perrig, 2008).

Academic motivation and brain-based learning

Motivation is a very important variable in success of learning outcomes. This explains why highly motivated students tend to show more academic efforts and perseverance and achievement than low motivated students in classroom activities and tasks (Wolters and Rosenthal, 2000). There are many factors that affect students' motivations in science education included the interests of students towards subjects, their notes which were taken in classroom, students' perceptions of task, success and failures of obtaining scientific knowledge, the general aim and orientations of students in science and understanding of scientific achievements (Tuan, 2005). Brain-based learning is a natural, motivating, and positive way to maximize learning due to following the ways our brains work (Caine and Caine 2006). It is favorable to change the teaching and learning environment from that of teacher dominance (teacher-centered approach) into that of student autonomy (learner-centered learning approach). These environments should be secure, safe and non-threatening learning experiences in order to maximize learners' enthusiasm and motivation to learn (Moghadam & Araghi, 2013). The educational environments that give students the opportunity to experience activities and are compatible with the brains' natural learning systems will, for sure motivate students to learn and succeed, as well as being creative thinkers (Ashraf Atta, 2017). Brain-Based Learning strategies effectively caused students to succeed, and this in turn created a positive student perception and motivation to learn.

Method

Quasi-experimental research method are used, quasi-experimental research is research that resembles experimental research but is not true experimental research. Although the independent variable is manipulated, participants are not randomly assigned to conditions or orders of conditions because the independent variable is manipulated before the dependent variable is measured, quasi-experimental research eliminates the directionality problem.

Participants

The sample was selected from students in the tenth grade in basic education in the Sultanate of Oman. The participants in this study were 75 preparatory school students. Experimental group (EG) consisted of 37 students while the control group (CG) consisted of 38 students. In both groups, students' social, economic statuses, intelligence and previous scholastic achievement were nearly the same. The students' ages in both groups ranged from 15 to 16 years. The participants were selected by convenience random sampling. The sample was randomly divided into two groups; experimental (n= 37 boys only) and control (n= 38 boys only). The two groups were matched on age, IQ, achievement, working memory and motivation.

Variable	Group	N	M	SD	T	Sig.
Age	Experimental	37	148.57	2.84	0.472	0.547
	Control	38	148.31	2.91		
IQ	Experimental	37	108.18	6.13	0.796	0.383
	Control	38	108.59	6.53		
Achievement	Experimental	37	41.13	1.87	0.613	0.393
	Control	38	41.39	1.57		

Working memory	Experimental	37	45.32	3.17	0.823	0.315
	Control	38	45.66	3.21		
Motivation	Experimental	35	58.25	2.29	0.351	0.651
	Control	36	58.39	2.61		

Table 1. Pretest mean scores, standard deviations, T- value, and significance level for experimental and control groups on age (by month), IQ, achievement, working memory, and motivation.

DATA COLLECTION TOOL

1. *The Raven's Coloured Progressive Matrices Test.* The Raven's CPM is internationally recognized as a culture -fair or culture reduced test of non- verbal intelligence. This easily administered, multiple - choice pencil and paper test have no time limit, and comprises three sets of twelve matrix designs arranged to "assess mental development up to a stage when a person is sufficiently able to reason by analogy to adopt this way of thinking as a consistent method of inference" (Raven et al., 1993). The testee is shown a series of patterns with parts missing. The parts removed are of simple shape and have been placed below the matrix. The testee can either point to the pattern piece s/he has selected or write its corresponding number on the record form (Lezak, 1995). The total score is the total number of matrices completed correctly, and the test is thus scored out of 36. The retest reliability of the Raven's CPM was revealed to be .90. The degree of correlation between the Raven's CPM and the WISC revealed correlations of .91.

2. *Academic Achievement Test:* The end-of-year examination results of the participants in math standardized and marked by the teachers, and provided the summative evaluation scores for the analysis. Hence, scores in the math served as the measures of students' achievement.

3. *Working Memory scale: (A) Tests of Auditory Working Memory Digit Span (DS).* On the DS subtest from the Wechsler Memory Scale-Third Edition (Wechsler, 1997), participants hear increasingly longer sequences of single digit numbers. For the first portion of this test, participants repeat the sequence out loud in order of presentation (forward span). For the second portion, they recite the sequence in reverse order (backward span). Correct sequences across the two portions of the test are totaled to determine the Digit Span raw score**.** (B) *Tests of Visuospatial Working Memory Spatial Span (SS).* Also, from the Wechsler Memory Scale-Third Edition (Wechsler, 1997) and a visual analog of the DS test, during the SS subtest participants watch the examiner tap increasingly longer sequences of raised, blue blocks positioned arbitrarily on a white board. Participants tap the blocks in the same order they witnessed (forward span) or in the reverse order (backward span). Correct responses across forward span and backwards span trials are totaled to determine the Spatial Span raw score.

4. *Motivation Scale***:** The Academic Motivation Scale for Learning was utilized in the study to determine students' motivation towards learning. consists of 19 items and four sub dimensions. The intrinsic motivation sub dimension of the scale, which refers to the willingness to learn, has six items; the amotivation sub dimension, which refers to an unwillingness to learn, has five items; the extrinsic motivation-career sub dimension, which refers to learning for future occupation goals, has four items; and the extrinsic motivation-social sub dimension, which refers to learning in order to show success to around has four items (Aydın & Çekim, 2017). The scale has a six-point Likert-type pattern, ranging from strongly agree to strongly disagree. Coding of the scale was done by allocating scores as follows: strongly disagree=one point, mostly disagree=two points, partially disagree=three points, partially agree=four points, mostly agree=five points, strongly agree=six points. Only the items in the amotivation sub dimension among the scale items were negative. But, when point scoring, these items were also scored in the same way as the other items on the scale. The lowest average score that could be obtained with the sub dimensions of the scale was one, while the highest was six. For this study, Cronbach's alpha values were calculated as 0.906 for the intrinsic motivation sub dimension, 0.853 for the amotivation sub dimension, 0.836 for the extrinsic motivation-career sub dimension, and

0.786 for the extrinsic motivation-social sub dimension.

EXPERIMENTAL DESIGN

An experimental Pretest-Posttest Control-Group design was used in this study. In this design, two groups are formed by assigning (37) of the students to the experimental group and (38) to the control group. Students in the experimental and control groups were pretested and post-tested in the same manner and at the same time in the study. The bivalent independent variable was the brain-based learning program and it assumed two values: presence of the brain-based learning program (for the experimental group) versus absence of the brain-based learning program (for the control group). The dependent variables were the gains in scores on working memory and academic motivation scales from the pretest and posttest.

PROCEDURES

Pre-intervention testing : All the seventy-five students in grade ten completed The Raven's Coloured Progressive Matrices Test, which assesses students' intelligence; Motivation Scale, which assesses students' academic motivation , Working Memory scale, which assesses Auditory Working Memory Digit Span and Visuospatial Working Memory Spatial Span. Additionally , the end-of- year examination results of the participants in social studies standardized and marked by the teachers , and provided the summative evaluation scores for the analysis. Hence, scores in the social studies served as the measures of students' achievement. Thus, data was reported for the students who completed the study.

General Instructional Procedures: The brain-based learning program was conducted to the whole class by their actual teacher during the actual lesson period for 8 weeks with 50-minute sessions conducted three times a week. The program was designed based on the three basic fundamentals of brain-based learning, namely 'orchestrated immersion', 'relaxed alertness', and 'active processing'. In the 'orchestrated immersion' phase, The students, with the help of their teacher , used various pictures, power- point presentations, cartoons and comic strips. These helped them the concepts presented and the subject matter as a whole as well. As for 'relaxed alertness,' phase, cooperative learning was present. Students collaborated with one another. Students were asked to write down, share and discuss with their classmates. The aim was to eliminates fear in the learners while maintaining highly challenging environments. During the 'active processing' phase, the learner was allowed to consolidate and internalize information by actively processing it. simulations, group discussions, role plays and dramatization techniques were used in order to ensure the retaining of the obtained knowledge and to ease the structuring of this knowledge as well as applying it into new situations.

Fidelity of Treatment: To ensure that the brain-based learning program was delivered as intended by the researcher, the following four safeguards were implemented. The first safeguard was that the teacher received training to criterion in how to apply the brain-based learning program instructional procedures. The second safeguard was that teacher met with the researcher day after day and communicated daily with the researcher (as needed) to discuss any noteworthy occurrences that took place when implementing the brain-based learning program instructional procedures. Reported difficulties occurred rarely and usually involved the need to individualize further for a particular student to deal with a behavioral issue. Responses to issues such as these were discussed and implemented.

DATA ANALYSIS

A two-groups pre-post design was used to compare working memory and academic motivation before and after the intervention. T-test was conducted. At each time point (pre/post), the mean and standard deviation were used to summarize group responses .Probability levels of 0.05 or smaller indicated significant differences between the experimental and control groups means. The data collected through the pre-test and post-test were entered into Statistical Package for Social Sciences (SPSS) version 22.

RESULTS

It was hypnotized that there were differences in post-test scores mean between control and experimental groups on Working Memory Test.

Table 2. shows T. Test results for the differences in post- test mean scores between experimental and control groups in working memory. According to table 2., there has been found a significant difference the differences in post- test mean scores between experimental and control groups in working memory ($t=6.91$, $p= 0.00$; $p<0.01$) in favor of the experimental group.

Table 2. T. test results for the differences in post- test mean scores between experimental and control groups in working memory.

Test	Experimental	Control	T	Sig.
working memory	57.51	46.53	6.91*	0 .01

Note: **P <0.01

The second hypothesis was that there were differences in post-test scores mean between control and experimental groups on Academic Motivation Test. Table 3. shows T. Test results for the differences in post- test mean scores between experimental and control groups in academic motivation. According to table 3., there has been found a significant difference the differences in post- test mean scores between experimental and control groups in academic motivation ($t=10.36$, $p= 0.00$; $p<0.01$) in favor of the experimental group.

Table 3. T. test results for the differences in post- test mean scores between experimental and control groups in academic motivation.

Test	Experimental	Control	T	Sig.
Motivation	83.19	56.91	10.36**	0 .01

Note: **P <0.01

The third hypothesis was that there were there differences in pre- post-test scores mean of the experimental group on Workin Memory Test. Table 4. shows T. Test results for the differences in pre- post-test scores mean of the experimental group o Working Memory Test. According to table 4., there has been found a significant difference the differences in pre- post-tes scores mean of the experimental group on Working Memory ($t=7.59$, $p= 0.00$; $p<0.01$) in favor of post-test scores mean.

Table 4. T. test results for the differences in pre- post-test scores mean of the experimental group on Working Memory Test

	Post-test	Pre-test	T	Sig.
Working memory	57.51	45.32	7.59**	0 .000

Note: **P <0.01

The fourth hypothesis was that there were there differences in pre- post-test scores mean of the experimental group on Academ Motivation Test. Table 5. shows T. Test results for the differences in pre- post-test scores mean of the experimental group Academic Motivation Test. According to table 5., there has been found a significant difference the differences in pre- post-te scores mean of the experimental group on Academic Motivation ($t=9.88$, $p= 0.00$; $p<0.01$) in favor of post-test scores mean.

Table 5. T. test results for the differences in pre- post-test scores mean of the experimental group on Academic Motivation Te

	Post-test	Pre-test	T	Sig.
Motivation	83.19	58.25	9.88**	0 .000

Note: **P <0.01

Discussion

The Purpose of this study is to investigate the effect of a brain-based learning program on working memory and academic motivation among tenth grade Omanis students. The results of this study indicated great gains for students in the experimental group in both working memory and academic motivation. This goes in the same line with the results of many studies. For example, Ozden 's (2008) analysis of post-test and retention level tests revealed a significant difference between the groups favoring brain-based learning. Duman (2010) found that brain-based learning "…more significantly increased the students' academic achievement when compared to traditional teaching methods" (p. 2095). The experimental group showed a 47.25% increase from the pre-test to post-test, whereas the control group showed an increase of 21.75%.

The performance of the experimental group in post-test in working memory and academic motivation can be explained by the gain achieved by the experimental group due to the application of the brain-based learning program which was built in the light of the integrated approach. This goes in the same line with Safa El Aseer and others'(2005) claim that "Learning cannot be achieved by accident, but must be sought to by using techniques that stimulate the mind in certain ways in various fields, including art, crafts, music, body building tools, scientific stories, novels, trips, etc., It is not too late to plant a tree for self - enrichment and mental development"(p. 204).

The mean scores of the control group scores on the working memory and academic motivation were low, while those of the experimental group were high, although there are no differences between the mean scores of the two groups in pre-test. This indicates that the program built for brain-based learning has taken into account the needs of multiple learners and their desire to learn, unlike the control group that has been learning in the traditional way in most of our schools.

CONCLUSION

This study goes some way to understanding working memory and academic motivation in Omanis tenth grade primary students. The study shows that students in the experimental group, compared to those in the control group , develop robust working memory and academic motivation due to training in brain-based learning. The study shows that those young students have great chance of developing their g memory and academic motivation.

FUTURE RESEARCH AND RECOMMENDATIONS

As a result, teaching with program based on brain-based learning theory is effective in improving students' working memory and academic motivation, the study of the students and it improves and academic achievement. In this context, it is proposed that in the classroom teaching teachers should give place to the brain-based learning theory. As for research that can be done in the future, the impact of the Brain-based learning theory teaching on students for effect of another variables. The results of this study have supported the claim of effectiveness of the neurocognitive-based instructional model in enhancing working memory, and motivation. As a result of the robust evidence provided in this study, it is hoped that the neurocognitive-based instructional model will be applied in improving learner outcomes in the future. The pedagogical knowledge needs to be evidence-based. The research and practice communities need to continue to work together to support learning for all students to be ready for their futures

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