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# The effect of brain based learning on achievement, retention, attitude and learning process

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## Abstract

The objective of this research is to determine the effect of learning organized instruction which designed according to the brain based learning on achievement, retention, attitude and the learning process. Control grouped pre-test post- test experimental design has been applied in the research and qualitative data related to the learning process has been reached with an interview technique. The research revealed that brain based learning environment has a positive effect on the higher level learning, retention of the learning and the attitude toward course of the university students.

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*Key words:* Brain based learning; achievement; retention; attitude; learning process; basic level learning; higher level learning.

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## 1. Introduction

Scientific developments bring changes to the learning approaches. Findings in the field of Medicine have provided acknowledgement of the human brain and a better understanding on how humans learn. This has caused a new learning approach to arise. Brain based learning is a student centered approach which is presented to assure 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.

Different than traditional methods, brain based learning emphasizes meaningful learning instead of memorization. In other words, the brain does not easily learn things that are not logical or meaningful and that structuring constructing is important. There is a resistance against learning decomposed information because the natural tendency in the brain is the integration of information. Because learning always depends on wide meanings and purposes, teachers need to help students see the meaning of new information. Both teachers and students should use stories, complicated subjects and metaphors in order to associate information and apprehension (Caine & Caine, 1995) The brain is coerced when there are activities it has to do by using its capacity and encounters patterning; in order to be able to do this it has to be in a non threatening environment. This very function of the brain is called flow

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by psychologists and cognitivists (Abbott, 1997). Goleman (2000) explains flow as a situation where an individual forgets himself, focuses on what he is doing and enjoys it. The marks of the patterning occurring during activities like these continue forever and are frequently used as solutions to new problems and base to new opinions. They need to be assisted in order for learners to start flowing by organizing suitable conditions. Support need to be provided to learners on continuing their development and renewing their objectives by protecting high struggle and low level of stress and allowing learners to organize their steps (Jensen, 1994).

The principles need to be understood and applied to the class in order for brain based learning to be understood and applied. These are given below (Caine & Caine, 1991)

- The brain is a parallel processor.
- Learning engages the entire physiology.
- The search for meaning is innate.
- The search for meaning occurs through “patterning”.
- Emotions are critical to patterning.
- The brain processes parts and wholes simultaneously.
- Learning involves both focused attention and peripheral perception.
- Learning always involves conscious and unconscious processes.
- We have at least two different types of memory: a spatial memory system and a set of systems for rote learning.
- We understand and remember best when facts and skills are embedded in natural, spatial memory.
- Learning is enhanced by challenge and inhibited by threat.
- Each brain is unique.

The environment which the brain needs comes to light when the above given principles are taken into account. These principles show how brain based learning can be applied to the learning-teaching process.

### *1.1. The Purpose of The study*

In this study, the effects of instruction which is organized according to the brain based learning approach on achievement, retention, the attitude of the students toward the course and the learning process are examined to determine whether there is a difference compared to the traditional instruction. As a result of the limitations of the traditional teaching, the effects of brain based learning are introduced in the research as a new alternative.

## **2. Method**

Qualitative and quantitative research designs are used together in the research. “Control grouped pre-test and post- test experimental design” has been used in the research. The achievement, retention and attitude score averages of the students in the experiment and control group have been compared. Interviews have been conducted related to the research process in order to provide qualitative data.

### *2.1. Participants*

The research has been conducted on an experiment and a control group consisting of third year students at Gazi University, Industrial Arts Education Faculty, Department of Educational Science which trains “Technology and Design” teachers to primary schools. In order to determine the equivalence of the groups, the averages scores of the students in both groups in the “Student Selection Examination” and their academic averages in the faculty have been compared with independent t-test and the groups have been found to be equivalent on both measures.

## 2.2. Instruments

In the research, in order to collect data; basic level learning test, an instrument consisting of open ended questions for measuring higher level learning and attitude scale have been developed. Apart from this, semi-constructed interview form has been prepared for interviews with experiment group students. According to Bloom's Taxonomy, the basic level learning test has been developed for measuring knowledge, comprehension and application level objectives and consists of multiple choice items. For the content validity of the test, experts' opinions have been called upon and a 50-item final form has been established at the end of the item analysis. In the test statistics related to the reliability of the final test, it has been found that the internal consistency reliability coefficient value is 0.77 (*KR-20*) and split-half reliability is 0.83.

In order to measure the realization level of higher level objectives, an instrument consisting of six open ended items for the measuring of objectives at analysis, synthesis and evaluation levels have been established after referring to expert opinions. These items have been scored by 3 separate scorers with a scoring key. According to the analysis of variance (ANOVA) results, a significant difference has not been found between the scores of the three scorers ( $F_{(2,261)}=0.01$ ;  $p > 0.05$ ). Scorers have scored the answers given to the higher level learning test similarly. This shows that the scoring was reliable.

At the end of the factor analysis (principle components analysis) conducted, attitude scale has been made up of 18 positive and 17 negative items. According to the factor analysis results, the item factor loads are between 0.40 and 0.70 and the item total correlations range between 0.24 and 0.64. The instrument has a single dimension structure and the variance rate explained by this single factor is %31. This value has been seen to be sufficient because a single factor scale has been developed (Büyüköztürk, 2003). The Cronbach's alpha reliability coefficient of the instrument is 0.90. In order to provide data for the related learning process, interviews have been conducted with the experiment group students and descriptive analysis has been conducted on the interview notes.

## 2.3. Experimental process

The research has continued during the academic term consisting of 14 weeks. Instruction with an approach called "traditional teaching" where mostly straight lecturing and question-answer techniques are used has been given to the students in the control group and the education to this group hasn't been interfered. On the other hand, the basic characteristics of the teaching environment designed according to the "brain based learning" approach applied to the experimental group is given below.:

- Integration between all lesson subjects has been provided.
- Examples the students have experienced have been used and their relativity with the subjects has been established.
- Resource richness has been provided with the integration of various and current resources from press and media and internet with the lesson content.
- Importance has been given to motivation in the class.
- The students being in an environment where the individual implications of the students and their opinions has been provided.
- Activities in which individual opinions are developed in a brain based learning environment are given.
- Richness on resource, lesson instruments, devices and methods in the classroom has been provided.
- The maintenance of comfortable and multi dimensional communication has been provided with the absence of a threatening atmosphere.
- Student participation has been provided and encouraged.
- Students working together have been provided by establishing small groups; having students share what they have learned together with the class and have them search solutions by giving them problem situations.
- A special attention has been paid to what the students feel during learning, their being in positive feelings, make them feel they are important, establishing relations between real life and the subjects.
- Creative drama, writing papers including their learning experiences, expressing what they have learnt with graphics, concept maps, problem solving and similar methods and activities have been applied.

- In order for the content to be meaningful, events, examples and subjects taken from current and real life have been used.

### 3. Findings and Comments

Findings and comments are presented according to the below research questions.

3.1 *Is there a significant difference between the basic level learning achievements of the groups to whom brain based learning and the traditional learning approach has been applied?*

First of all the basic level learning pre-test score averages ( $\bar{X}$ ) and the standard deviation (S) of the groups have been calculated and an independent samples 't' test has been applied. The results of the analysis have been given in Table 1.

Table 1. The Comparison of Basic Level Learning Pre Test Score Averages

Group	N	$\bar{X}$	S	df	t
Experimental	40	22.00	5.12	78	2.00*
Control	40	24.10	4.23		

\* $p < 0.05$

In Table 1, it has been seen that while the basic level learning pre test score average of the experiment group is 22.00, basic level learning pre test score average of the control group is 24.10. Both groups have reached different score averages on the basic level learning pre test prepared and applied according to the objectives at knowledge, comprehension and application levels before the experimental process begins.

When this difference was tested with the independent samples t test, it was found to be significant on a level of 0.05 ( $t_{(78)}=2.00$ ,  $P < 0.05$ ). Because there is a significant difference on the pre test scores between the experiment and control groups, an answer was searched for the first sub problem by applying a covariance analysis. The post test averages and standard deviation obtained by taking difference between the pre test score averages in consideration is presented in Table 2.

Table 2. Descriptive Statistics of Basic Level Learning

Group	N	Pre Test		Post Test		Corrected Post Test	
		$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Experimental	40	22.00	5.12	33.28	5.42	33.54	0.71
Control	40	24.10	4.23	33.20	3.47	32.94	0.71

Like it is seen in Table 2, when the basic level learning pre test score averages of the groups are taken under control, the post test averages show slight differences. According to the corrected scores, while the basic level learning post test average of the experiment group was 33.54, the basic level learning post test average of the control group was 32.94. Based on this situation, the difference between post test averages of the experiment group and the control group is 0.06. Whether this difference is significant or not is determined with the analysis of covariance conducted. The analysis of covariance results showing whether there is a meaningful difference between post test score averages of the groups are given in Table 3.

Table 3. Analysis of Variance for Post Test Basic Level Learning

Source of the variance	Sum of Squares	Mean squares	df	F	P
Group	6.927	6.927	1		
Error	1505.370	19.550	77	0.35	0.55
Total	1512.297		78		

$p > 0.05$

When Table 3 is looked over it is seen that the difference between the basic level learning post test averages of the experiment and control group isn't significant ( $F_{(1,77)}=0.35$ ,  $p > 0.05$ ). According to this finding, there isn't a difference between the brain based learning activities applied to the experiment group and the traditional learning applied to the control group on the basic level learning of the students. It could be said that brain based learning and traditional teaching effect the basic level learning of the students on a similar level. According to the research of Budak (1999), on the basis of achieving the target behaviors of the knowledge level, it is seen that there isn't a significant difference between the achievement scores of the group where lessons were held on traditional methods and the group where activities to use the whole brain were used. With this aspect, there is a similarity between the findings of the two studies.

3.2. *Is there a significant difference between the basic level retention achievements of the groups to whom brain based learning and the traditional learning approach has been applied?*

Independent samples 't' test, applied in order to determine whether there is a significant difference between the basic level retention achievement averages applied to the experiment and control groups, are given in Table 4.

Table 4. Comparison of the Basic Level Learning Total Retention Score Averages

Groups	N	Post Test $\bar{X}$	Retention $\bar{X}$	Achievement $\bar{X}$	Achievement S	Difference Between Achievements	t
Experimental	40	33.28	31.15	-2.13	7.37		
Control	40	33.20	28.98	-4.22	5.90	2.09	1.96*

$p > 0.05$

As seen in Table 4, the difference between the post test and retention score averages of the basic level learning of the students in the experiment group is -2.13 and -4.22 in the control group. The difference score of the retention achievements between the two groups is 2.09. It is seen that this difference between the retention achievements of the groups to whom brain based learning and traditional teaching are applied is significant. ( $t=1.96$ ,  $p > 0.05$ ). The retention score averages of both experiment and control groups are lower than the post test score averages. These findings show that there isn't a significant difference between experiment and control groups on terms of the retention of basic level learning.

3.3. *Is there a significant difference between the higher level learning achievements of the groups to whom brain based learning and the traditional learning approach has been applied?*

Independent samples 't' test have been applied in order to determine whether there is a significant difference on the higher level learning achievement scores between the students in the groups where traditional teaching and brain based learning is applied.

Table 5. The Comparison of Higher Level Learning Total Achievement Score Averages

Groups	N	Pre Test $\bar{X}$	Post Test $\bar{X}$	Achievement $\bar{X}$	Achievement S	Difference Between Achievements	t
Experimental	40	1.08	16.25	15.17	6.21	5.35	4.19*
Control	40	1.03	10.85	9.82	5.16		

\* $p < 0.01$

As it is seen in Table 5, the higher level learning achievement score averages of the students in the experiment group is 15.17 and the achievement score averages of the students in the control group is 9.82. The difference of achievement score averages between the two groups is 5.35. According to the analysis results conducted to determine whether there is a significant difference, it is determined that there is a significant difference of 0.01 between the achievement score averages of the groups ( $t=4.19$ ,  $p<0.01$ ). It has been found that there is a significant difference in favor of the experiment group between the higher level achievement scores of the experiment and control groups. In other words, the group that established more progress compared to the higher level learning achievement scores is the group that brain based learning is applied. It could be said that brain based learning is more effective than the traditional teaching on the developing of higher level learning of the students.

Jackson (2001), found that students to whom teaching towards the dominancy of brain sphere is applied are more successful than traditional teaching is applied at university level. Moreover, Rooney (1991) has stated that methods suitable to the brain improve the learning success. Wortock (2002) has indicated that brain based learning improve critical thinking success. According to Jensen (1998), a quality education should encourage the research of alternative thinking, multi answers and creative ideas. Moreover, Williams (1999) has stated that brain based learning activities can make everybody successful. As it could be seen, this finding that displays the efficiency of brain based learning on terms of higher level learning, overlap with some of the research results in the field literature.

#### 3.4. Is there a significant difference between the higher level retention achievements of the groups to whom brain based learning and the traditional learning approach has been applied?

Whether there is a meaningful difference between the higher level learning retention achievement scores of students in experiment and control groups has been analyzed with an independent sample 't' test. The analysis results are given in Table 6.

Table 6. Comparison of Higher Level Learning Total Retention Score Averages

Groups	N	Post Test $\bar{X}$	Retention $\bar{X}$	Achievement $\bar{X}$	Achievement S	Difference Between Achievements	t
Experimental	40	16.25	10.55	-5.70	6.16	2.35	1.94*
Control	40	10.85	2.80	-8.05	4.56		

$p < 0.01$

According to Table 6, the difference between the higher level learning retention score averages of the experiment group and the post test score averages is -5.70, the difference between retention score averages and the post test score averages of the control group is -8.05. The difference of achievement scores of the two groups after retention is 2.35. When the difference between higher level learning post test and retention score averages of the brain based learning and traditional teaching are compared, the difference found between them was meaningful at a level of 0.01 ( $t=1.94$ ,  $p<0.01$ ). According to this finding, brain based learning and traditional teaching has a different effect on the higher level learning retention of the students. Brain based learning is more effective on the retention of higher level learning compared to traditional teaching. In the research on the retention of learning by Jackson (2001), it is seen that the retention of learning is provided in the experiment group where university level learning styles and brain sphere dominancy teaching has been applied. Retention could not be provided in the group traditional method

is used. Feelings established related to a certain learning experience directly effects the remembering capacity of the individual. The brain which receives a threat feeling from the learning experience prevents the remembering of information related to this experiment (Baylor, 2000). Apart from that, when the brain notices that the experience is important most of the learning is permanent. (Caulfield, Kidd & Kocher, 2000). The establishing of discussion groups, conducting exercises, using the learned items and peer teaching activities also provide the retention of the learning (Sousa, 2001).

3.5. Is there a significant difference between the attitudes of the students in groups where brain based learning is applied and the group where traditional teaching is applied?

In order to find an answer for this question, it has been searched whether there is difference between the pre attitude scores of the experiment and control groups and independent samples ‘t’ test have been applied.. The results of the analysis are given in Tablo.7.

Table 7. The Comparison of Pre Test Results Relating to the Attitude Scores Toward the Course

Group	N	$\bar{X}$	S	df	t
Experimental	40	125.55	18.85	78	3.12*
Control	40	136.50	11.71		

\*p< 0.01

As seen in Table 7, while the attitude scale pre test score average of the experiment group is 125.55, attitude scale pre test score average of the control group is 136.50. Before the experimental process began, two groups have reached different score averages on the attitude scale. When tested with a t test, this difference was to be significant on a level of 0.01 ( $t_{(78)}=3.12, P< 0.01$ ). Because there is a significant difference between the pre attitude score averages, covariance analysis has been applied in the search of a reply to the this sub problem.

In Table 8, it is seen that post attitude score averages show difference when the pre attitude score averages of the groups are taken under control. According to the corrected scores, the post attitude score average of the experiment group is 142.53 and the post attitude score average of the control group is 133.33.

Table 8. The Descriptive Statistics of the Attitude Score Averages Relating to Classroom Management Lesson

Groups	N	Pre Attitude		Post Attitude		Corrected Post Attitude	
		$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Experimental	40	125.55	18.85	139.90	18.88	142.53	2.37
Control	40	136.50	11.71	135.97	13.31	133.33	2.37

The analysis of covariance results showing whether there is a meaningful difference between the post attitude score averages of the two groups are given in Table 9.

Table 9. Results of Covariance Analysis Relating to the Attitude Toward Classroom Management Course

Source of the Variance	Total Squares	Average of Squares	Sd	F	P
Group	1504.934	1504.934	1	7.08*	0.00
Error	16363.43	212.512	77		
Total	21130.69		78		

\*p< 0.01

When Table 9 is analyzed, it is seen that the difference between corrected post attitude score averages of the experiment and control groups is meaningful on a level of 0.01 ( $F_{(1,77)}=7.08, p<0.01$ ). This finding show that brain



based learning provides the attitude of the students to the lesson is more positive compared to the beginning. It could be said that brain based learning activities applied in the experiment group increase the attitude scores of the students to the lesson. In the experimental group, teaching towards learning styles and brain sphere dominancy, student attitudes in a research conducted in a microbiology lesson at university level has been evaluated with an attitude instrument towards science. It has been found that student attitudes show a meaningful increase compared to the students in the traditional group (Jackson, 2001).

In Hoge's (2002) research where he analyzed the integration of brain based learning and literacy acquiring; it has been seen that brain based learning strategies positively effect the attitudes of the students to literacy and that students seeing themselves as literate is positive. According to Hoge (2002), brain based learning facilitate students developing positive literacy experience and motivate students to being literate. In order for students to develop positive attitudes, Hardiman (2001) suggests the teaching of peer acceptance and social behaviors. Moreover he suggests the using of methods that evoke feelings like drama, jokes, movement and art in order for feelings to be associated with learning.

### 3.6. How does brain based learning approach effect the learning environment?

The descriptive analysis of the data from interviews conducted with students in the experiment group have been conducted according to the codes and themes established during the research. According to this, the main qualitative findings obtained related to the characteristics of the brain based learning environment are summarized below:

- Brain based learning require content to be given in a meaningful whole instead of unrelated information pieces in order for it to carry meaning on terms of the students. In the interviews conducted with students, the benefits of a lesson being organized around a collective concept have been stated. A student has stated his opinion like this: ***“For example we had discussed the teacher characteristics I had written in class and this had attracted the attention of both the teacher and the class... in the following weeks we tried to reach these ideal teacher characteristics that we had established.”***
- Feelings that are among the principles of brain based learning is an important power effecting learning. That's why importance should specially be given to the feelings of students in a lesson organized according to brain based learning. During the interviews with students, it has been seen that there are various statements showing that student feelings are evoked in the class. Some examples: ***“We were comfortable in the class. We got to know ourselves better, we found chance to express ourselves, and we got to know each other better with this chance”, Fort the first time in my life I talked about my own education life during class, in an objective way. This is probably because of the positive atmosphere of the lesson and class. Together with class contribution it became a very nice lesson.”***
- Making choices about learning ways has positively affected student participation and student opinions related to the lesson.
- In the group where brain based learning was applied students were in positive feelings during the lesson. The activities conducted in the classroom have increased the student recognition of each other and working together. Varieties in method and techniques and classroom applications have provided affective lesson participation on terms of the students. Students have expressed their feelings like this: ***“In most of the lessons either us or the teacher is talking, but in the classroom lesson we were making discussions based on application, writing things and always doing different activities.” “Scientific articles have been read and we wrote our own comments and writings about these. In the following weeks some of our friends demonstrated the subjects in a drama.”***
- Brain based learning has become a choice students participate happily. A student has expressed his feelings like this: ***“We were usually doing activities related to the lesson during class hours. After the class ended we would always discuss with friends for about 10-15 minutes. This was very effective on us, we were reviewing all we did once more in order to find out whether we could have followed a different way or whether we followed the wrong way or not. This of course provided us to study at home after class whether we want or not. Apart from that we were researching articles about the lesson and in the meanwhile we were looking into a lot of subjects along with the main subject.”***
- Students in the class where brain based learning is applied have stated that their personal participation is consistent and affective. A student has stated that their participation in the class and their learning after the



lesson continued with these words: *“The lesson was very interesting and everybody was putting forward an opinion and none of us was saying that’s his opinion, and we were discussing about what counter opinions are, why is this correct and why this isn’t. In none of the lessons did I see a lesson lengthen apart from when we were made to, but this lesson went on for over 15-20 minutes with our request. We would continue among ourselves after class. That’s why I can easily say that we had a responsibility of being active and we were doing this voluntarily. We would always participate in the lesson.”*

- When the students were requested to comment on the contributions of the lessons to them, some of the students have talked about objectives they have reached. The opinion of a student is: *“In a lot of class objectives at information level is being achieved. In this lesson however we had the chance to practice and even make analysis. We were discussing and commenting. In those activities that we were doing we could see all of these.”*

#### 4. Conclusion and Suggestions

According to the findings obtained from the brain based learning activities, in the earning of basic level learning and the retention of basic level learning, brain based learning activities and traditional teaching has similar affects. According to the research findings, it is seen that the higher level learning achievement scores of students in groups where brain based learning is applied is higher than the higher level learning achievement scores of the group where traditional teaching is applied. Moreover, the students in the group where brain based learning is applied have continued the higher level learning they have achieved at the end of the experiment application after the experiment as well. Brain based learning activities have been affective on providing the retention of higher level learning. In the research; it has been seen that the difference of pre attitude and post attitude scores of students in the group where brain based learning is applied is meaningful. The brain based learning activities applied to the experiment group has increased the attitude of student scores towards the lesson. Related to the brain based learning environment, students have stated that content has been presented in a meaningful whole, importance has been given to their feelings and that they have had a rich learning life organized according to the student preferences. Moreover, affective communication, sensitivity on individual differences, democratic attitude, active participation to the lesson, continuity of the lesson and the variety approach in evaluation have been determined as the positive aspects of the approach.

- The below suggestions have been made on the direction of the results obtained from the research.
- As it is seen in this research, brain based learning and traditional teaching have similar affects on achieving basic level learning. On the achieving of higher level learning on the other hand, it is seen that brain based learning is more affective. Brain based learning environments also positively affect the attitudes of students towards lesson. Brain based learning must be an approach preferred in lessons.
- Neurologists and pedagogists can come together and conduct brain based learning researches. By doing this they can analyze how the brains of students work on which activities and can reflect the results to teaching applications.
- Researches where brain based learning is applied can be conducted in different degree and levels of teaching and in different areas of discipline and the results can be compared with this research.
- The structure and function of the human brain, brain based learning principle and applications in the training process of teacher candidates can take place and the affects of this to the learning process and their future learning processes of the teacher candidates can be researched.
- In recent years, although it is stressed that the brain works as a whole, in order to develop the brain based learning applications, the results obtained from the analyzing of the brain semi mass dominance, learning style preferences can be reflected to the learning-teaching process. In brain based learning applications, researches where arrangements suitable to the characteristics of students can be planned and realized.

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