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Brain-Based Learning Studies in Turkey: A Review for Methodological Analysis *

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Abstract

Many researches have been conducted about how learning occurs for years. Educators have tried to organize teaching-learning process in accordance with the brain researches and "brain-based learning" concept has emerged. Although neuroscience studies confirm that there is a relationship between brain and learning, it is also stated that making generalizations about how teaching should be in class can be risky. This study is aimed to present a methodological analysis on the brain based studies in Turkey. Teaching activities used in this study have also been analyzed. Accordingly, postgraduate thesis and articles in Turkey were analyzed and evaluated with a rubric according to these categories: the suitability of the method to the research problems, whether the scientific method is applied properly or not (population and sample selection, identification of variables, conducting the experimental process, suitability of the measurement tool to the aim of the research, reliability and validity studies, findings, results and recommendations) and the suitability of findings to the research problems. Criteria were determined for each category in the rubric and rated as poor, fair, and excellent. According to the results, it was found that examined studies were generally evaluated as fair methodologically. Teaching activities were exemplified, weaknesses and strengths of the studies were discussed.

Keywords

Brain-Based Learning
Brain-Compatible Learning
Brain Friendly Learning
Methodological Analysis

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Introduction

How learning occurs has been questioned by many scientists for thousands of years that formal education began. Many theoreticians affected by their own scientific developments and paradigm in their age have tried to explain the learning process. In recent years, both the accumulation of knowledge and technological advancements have created study fields such as educational neuroscience studies to examine the relationship between brain and learning. On the basis of studies on brain, the usage of the concepts such as "brain-compatible learning" (Ronis, 2007), "brain-

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friendly learning" (Biller, 2003), and "brain-based learning" (Jensen, 2008) have increased and educators started to organize teaching and learning process by using the explanations of these approaches.

While "brain-compatible learning" and brain-friendly learning" consist general recommendations for the organization of learning, recommendations and principles of "brain-based learning" offered by Caine and Caine (1991:13), are used for organizing the domain specific teaching fields as an holistic approach by practitioners and it is discussed in the application oriented studies especially in Turkey. In this study, studies about the application and evaluation activities of the "brain-based learning approach" by Caine and Caine (1991) were focalized. For this reason, in order to understand the reasons of this study, explanations and criticisms for Caine and Caine' s brain-based learning were presented in the following paragraphs below.

Caine and Caine (1991: 13) explains "brain-based learning" as knowing the principles of brain for meaningful learning and organizing teaching process considering these rules. Brain is the organ which directs the voluntary and involuntary (pulsation, respiration, digestion etc.) movements of human body. Complex mental activities such as thinking and learning are also directed by the brain. According to Pool (1997), Caine and Caine justifies the reason why he called his approach as "brain based learning" by stating that "*of course all learnings are brain based, but if we just said "learning," then people might not understand what we were talking. Humans have a marvelous brain, whose possibilities appear endless. So when we refer to brain-based learning, we are concerned about maximizing learning—understanding how the brain works best."*

Caine and Caine (1991:14) stated that multiple and concrete experiences are necessary for meaningful learning. They emphasized the importance of associating the knowledge with other fields and personal sense-making for a meaningful learning. Caine and Caine (1991:17) indicated that main components of brain based learning are organizing appropriate and enriching experiences from real life and providing experiences which increase the assimilation of the knowledge and meaning for students. These inferences for meaningful learning based on rich experiences offered by Caine and Caine's brain based learning have been supported by many educators from Dewey (1938) for about hundred years.

Caine and Caine (1991) specified twelve principles of brain-based learning and gave some advices for each principle about how they can be used in class. These twelve principles of brain-based learning are:

1. The brain is a parallel processor
2. Learning engages the entire physiology
3. The search for meaning is innate
4. The search for meaning occurs through "patterning"
5. Emotions are critical to patterning
6. Every brain simultaneously perceives and creates parts and wholes
7. Learning involves both focused attention and peripheral perception
8. Learning always involves conscious and unconscious processes
9. We have at least two types of memory -- a spatial memory system and a set of systems for rote learning
10. The brain understand and remembers best when facts and skills are embedded in natural spatial memory
11. Learning is enhanced by challenge and inhibited by threat
12. Each brain is unique

Considered the Caine and Caine's brain-based learning principles and recommendations, it is seen that the definition of brain-based learning is not an approach for teaching or a method, indeed it is an advice list for organizing teaching. In literature, there are some kinds of advices based on brain studies. For example, Jensen (2004), advised activities for a better learning related to brain based

learning emphasizing that each brain is unique. Clemons (2005) also shared about the findings on brain, explained the brain based learning and emphasized the points taken into consideration for teaching and learning process. Moreover, Duman (2012) also explained the performances in class relating models and strategies about brain based learning.

On the other hand, learning principles and recommendations about teaching of the brain based learning approach of Caine and Caine have been criticized by some authors writers (Kelly, 2011; Ansari, Coch ve De Smedt, 2011) as they are not based on satisfactory scientific facts. In addition, some principles (such as 1, 6, 9and 12) are very general ones about the function of brain. Principles and some of the recommendations are also related to learning psychology studies rather than new definitions of brain based learning. For example, the principle that learning is enhanced by challenge and inhibited by threat is explained initially by Pavlov's classical conditioning before cognitive theorists then Skinner's (cited, Hill 1971) operant conditioning theory principles such as (cited Gibson and Chandler) positive and negative reinforcement.

Most of the criticisms to the brain based learning come from neuroscience studies. Educational neuroscience is a subfield of cognitive neuroscience and aims to present the relation between learning and brain based on scientific evidences. Educational neuroscience is not just related with physiological and biological mechanism of human, it is a multidisciplinary approach based on teacher and student learning and mind and brain. This interdisciplinary approach involves collaborative study of educational theorists, researchers, executives and decision-makers (Campbell, 2011). Thus, it should not be thought that it is just a field limited with laboratory studies. In this field, instead of groundless claims for educational implementations and recommendations about brain and learning, it is aimed to get scientific evidence (Campbell, 2011; Geake, 2011; Koizumi, 2011; Stein and Fisher, 2011; Schwartz and Gerlach, 2011).

Although the studies on neuroscience confirm that there is a relationship between brain and learning, it is also stated that it is risky to make generalizations about how instruction should be in classes. Researchers (Davis, 2004; Willis, 2008; Immordino-Yang, 2011) warn that it is not easy to explain the relationship between brain and learning and it is difficult to specify the holistic effect of many variables which affect learning. In addition, they stated that it is necessary to suggest the biological support of principles and attribute them to scientific ground; otherwise applying unproven principles can be very risky for students.

Caine and Caine's twelve principles described above have been implemented not only in class by teachers but also in experimental studies by researchers. In this study, based on the criticism towards "brain based learning" summarized above, it is aimed to examine the methodological qualities of brain based learning studies and learning activities of these studies in scientific process.

Aim of the Study

This study aimed to examine the brain-based learning studies methodologically in Turkey. Accordingly, postgraduate thesis and articles in journals were analyzed and evaluated. The methods of the studies were evaluated according to specified criteria: suitability of the research method to the research problems, whether the scientific method is applied properly or not (population and sample selection, identification of variables, conducting the experimental process, suitability of the measurement tool to the aim of the research, reliability and validity studies, findings, results and recommendations) and the suitability of findings to the research problems. At the same time, it is aimed to examine the teaching activities used in brain-based learning activities. Research problems are:

1. What are the methodological qualities of the brain-based learning studies in Turkey?
2. What kinds of learning activities are implemented and what kinds of learning environments are created in brain-based learning studies?

Method

Research Design

In this study, descriptive research design was used. Descriptive research seeks to explain the interactions between the situations considering the relations of present situations with the previous events and conditions (Kaptan, 1998). Descriptive researches are research approach to describe the things that occurred in past or still existing. The incident, person or the object which are the subjects of the research tried to identify under their own conditions and as they are (Karasar, 2005).

Measurement Tool

In this study a rubric (see in Appendix 1) was developed based on the literature review (Cohen, Manion, & Morrison, 2007; Kaptan, 1998; Karasar, 2005). The rubric includes eight categories and twenty three items. For each item three degrees are determined; poor, fair and excellent. The poor degree means that the methodological characteristic related to category is absent in the study, the fair degree means that the methodological characteristic related to category does not completely appears in the study and there are some deficiencies and excellent degree means that the characteristic appears completely and perfectly. The categories are problem status, research problems, research design, data collection, data analysis, findings, results and recommendations. Content validity of the rubric was determined by according to expert opinions (three experts) in order to evaluate whether the items cover all the characteristics of research methodology. For the reliability of the rubric, the inter-rater reliability was calculated. Six studies were determined randomly, and three researchers graded these researches individually. Fleiss Kappa coefficient was calculated as 0.54 using R software program (cran.r-project.org). These coefficient means that the strength of agreement degree of researchers is moderate (0.41-0.60) (Landis and Koch, 1977:165).

Data Collection

In the first phase of the study, master and doctorate dissertations were searched in the Turkey Council of Higher Education (https://tez.yok.gov.tr/UlusalTezMerkezi/) database on 25th February 2014. The database was searched with the concepts "brain based"; "brain" (limited in education and training) and "brain and learning" key words without year limitation.

At first, 38 dissertations were found for "brain based" key word, 28 dissertations were found for "brain" key word and 102 dissertations were found for "brain and learning" key word. Then irrelevant and repetitive dissertations were eliminated after reviewing the dissertation titles. After the first elimination, 39 dissertations left. The abstracts of 39 dissertations were read and 10 irrelevant topic or having non-experimental design dissertations were eliminated. 22 out of 29 dissertations were downloaded from the database. But, 7 dissertations were not permitted for full access. An e-mail was sent to authors of inaccessible dissertations but none of them replied. Therefore 22 dissertations were included in the study. It can be said that the inaccessible dissertations are the limitations of this research.

EBSCOhost (http://www.ebscohost.com/) and Google Scholar databases (http://scholar.google.com.tr/) were also searched to get the published researches. Same key words are used without year limitation in these databases. In the first search, 57 articles were found. Only two of these articles were experimental studies conducted abroad. Abstracts of the articles were read and reviewed and they are eliminated as they were published from dissertations which are in the first place of research or they are non-experimental. The two experimental studies conducted abroad were excluded from the study due to lack of numbers will not give the opportunity for comparison with studies performed in Turkey. After this review 4 articles were selected for methodological analysis. Finally this study includes 26 studies in total; 22 dissertations and 4 articles.

In the second phase of the study, experimental processes of dissertations and articles were examined and learning activities or learning environment in brain-based learning researches were determined. Document analyses were used for this purpose. Three researchers reviewed the experimental processes of dissertations and articles individually. Then, they discussed about possible

codes to reach agreement in code categories. 91 codes and 10 categories were determined (see in Table 2). These categories are; visual material, technological material, physical needs, attention/motivation strategies, group studies, considering individual differences, multiple evaluation, other methods, learning atmosphere and organizing learning environment. Information about the applied learning activities and learning environment in the experimental process are limited in those dissertations examined.

Analysis of Data

Descriptive statistics were calculated with the data obtained from rubric. Percentage and frequency values were calculated for each item and category of the rubric. Then, these data were evaluated and discussed.

Thematic coding was used for the second research problem. Categories were determined after reviewing brain-based learning activities in dissertations and articles. Then, percentage and frequency values were calculated and findings were evaluated and discussed. Titles of the studies and the identity of the researchers examined were kept confidential for the force of research ethics.

Findings

Findings were presents in 2 groups: in two sections: methodological quality of researches and implemented learning activities.

Methodological quality of researches

Methodological quality of researches was categorized as problem status, research problem, research design, data collection, data analysis, findings, findings and recommendations (Table 1).

Table 1. Percentages of Methodological Quality of Researches

Category	Level of competency*							
	Excellent		Fair		Poor		Total	
	f	%	f	%	f	%	f	%
Statement of Research Purpose (4 items)	40	38	58	56	6	6	104	100
Problem of the Research (3 items)	39	50	38	49	1	1	78	100
Research Design (6 items)	66	42	45	29	45	29	156	100
Data Collection (4 items)	42	40	45	43	17	17	104	100
Data Analysis (2 items)	33	63	15	29	4	8	52	100
Findings (2 items)	39	75	11	21	2	4	52	100
Results	21	81	4	15	1	4	26	100
Recommendations	5	19	20	77	1	4	26	100

* Frequencies were calculated by adding to number of codes of items in each category.

Most of the studies (%56) were rated *fair* in *problem status* category. 38 % studies were in *excellent* category, but 6% of the studies were rated *poor.* Inadequate items in the *problem status* category are "questioning the relations between variables" and "defining secondary (functional) purposes". For example, one of the poor studies, while explaining the problem, data and findings about irrelevant variables were presented.

In terms of stating and explaining the *problem of the research*, %50 studies were found in excellent; 49% of them were found in fair degree. Only one research was rated poor in this category. In that research, it was determined that sub problems of the research involves more than one problem:

> *"Is there a statistical meaningful difference between the success level of the experiment group students taught with brain based learning approach and the control group students taught with traditional learning approach before and after experimental process?"*

Adequacy degree of the *research design* category was found 42% excellent and 29% fair in this study. In addition, *research design category* was found 29% poor degree. Considering the findings, it can be said that there may be some deficiencies about the *research design.* For example, experiment and control groups, steps of experimental process, duration of the experimental application etc. Some deficiencies were also determined about the topics such as "controlling the variables" and "enough time to experimental application to observe the effects of independent variable" In most of the studies "attitudes towards to lessons or BBL" variables were examined, but there wasn't enough time given to observe the differences resulted from the experimental process (4 weeks, 6 weeks, etc.).

Examined the studies in *data collection tool* and *data collection process* it was found that 43% was fair, 40% was excellent and 17% was poor. Thus, in terms of choosing the data collection tool, reliability and validity process, data gathering process most of the studies were found adequate. But, as not all the instruments explained the validity and reliability process, those items were not evaluated as excellent degree. For instance, one of the poor studies examined according to the category of data collection tool, in order to evaluate the eighth grade students' higher order cognitive skills science lesson achievement test was used and measurement tool was not diversified. Developing multiple choice tests was very difficult in order to evaluate higher order skills (Atılgan, Kan and Doğan, 2009). So, multiple choice achievement tests were not regarded as an appropriate data collection tool for measuring higher order skills and tests measuring performance and open ended questions measuring synthesis skills such as projects or researches that could measure analysis and synthesis skills, portfolios, performance homework are suggested. Also, in order to data variety, structured interviews, observation and self-evaluation scales can be preferred (Özsoy, 2008). It is important that only few studies were found adequate in terms of data collection process.

In terms of data *analysis process,* examined studies were found 63% excellent, %29 fair and %8 poor degree. Although most of the examined studies are adequate in terms of techniques to analyze the data and data analyze process some of them are not. To give an example from one of the studies rated as poor, in order to specify the effects of brain based learning on academic success and attitude, data from 16 student group was analyzed using t-test. For the data sets which do not have normal distribution (Karasar, 2005; Cohen, Manion and Morrison, 2007) and observation number is below 30, parametric statistics are suggested as an appropriate way (Kalaycı, 2009).

Adequacy level of the 75% examined studies in terms of *findings* category research was found excellent, 21% were fair and 4% were poor degree. Although most of the examined studies were adequate in terms of findings topic, some of them are not. The studies examined in this research are mostly adequate in terms of findings are based on research data and some of them answers the research questions. For example, although the findings of 3 studies rated as fair did not present the answers of research questions, findings from the interviews were presented. In another study, as the findings do not overlap with the sub problems, it was evaluated as poor.

From the point of *results*, investigated studies were is in excellent level with 81%, 15% of all in fair level and 4% in poor level. According to this data, most of the study' results were based on findings. On the other hand, there are studies of which results were not based on findings:

In terms of *results*, it was found that 81% of the examined studies were excellent, 15% fair, 4% were poor. According to these findings, generally, the results of the studies based on findings. On the other hand, some studies' results were not based on findings:

> *"In this study, it was inferred from the questions or comments of students who answered "I don't like science" were interested in science. When teacher and students came to class being prepared with various materials and when students were informed about their own performance homework, they activated the different parts of brain and so this caused happiness hormones secretion."*

In conclusion, the studies examined in terms of recommendations were found 77% fair, 19% excellent and 4% poor degree. It can be said that recommendation are generally fair adequate for both practitioners and new researchers. One of the example recommendations that do not based on research results is like that:

> *"Education Faculty students should be educated about this topic and there should be a course about this topic in their curriculum"*

According to these findings, it was seen that the examined studies were generally adequate in fair level methodologically.

Learning Activities Implemented In Brain-Based Learning Studies

Learning activities implemented in brain based learning studies are presented in Table 2 below. Ten categories were determined from content analysis.

Table 2. Learning Activities Implemented in Brain-Based Learning in Their Experimental Processes

	Categories and Codes	**Number of Codes**	**f**	**%**
1.	Visual material (Poster, photo, picture, cartoon, clip board, brochure, map / atlas / globe, color choice of materials, samples and collections, table, board, graphics, model /maquette)	13	58	14.91
2.	Technological material (Animation, slide / PowerPoint, cd, movie, projector, computer, video, web based educational games, overhead projector, camera, internet)	11	44	11.31
3.	Physical needs (Informing about balanced nutrition, drink water /beverage during the lesson, move freely in classroom, eating candy / chocolate / dessert during the lesson, ventilation, informing about how to keep body fit / importance of sleep, temperature of class, wc need)	8	59	15.17
4.	Strategies of drawing attention/motivation (Informing about brain, making aware of the target, informing about time management, giving examples about real life, improving self-confidence, activating prior knowledge)	6	21	5.40
5.	Group studies (Group studying, creating homogeneous groups, creating heterogeneous group)	3	16	4.11
6.	Taking into consideration personal differences (Form for students recognition, take into account the learning styles, appealing to different sensory organs, organizing activities according to the level of students and their interests, taking into account individual learning speed, brain dominance instrument)	6	18	4.63
7.	Multi-dimensional evaluation (Worksheets, evaluation sheets, concept maps, diaries, portfolios, multiple choice test, open ended question, gap fill questions, self-evaluation, group evaluation, homework, exercises, quizzes)	13	43	11.05
8.	Other methods (Project, question-answer, analogy, comparison, imagination works, schema creation, preparing graphics, creating concept maps, drama, game, mastery learning, making experiments, puzzles, writing story/writing poem/ drawing cartoon, discussion, learning by doing, active participation, brain storming, meaning analyzing table)	19	57	14.65
9.	Learning atmosphere (Decreasing stress, interaction with group friends, listening to music, creating affective climate, behaving students in an equal way, effective communication, creating teacher guidance, creating competitive environment, creating positive competitive environment)	9	46	11.83
10.	Arranging learning environments (Classroom/laboratory/garden/room of informatics/conference hall/appropriate environments out of school, seating, physical order of the class)	3	27	6.94
Total		91	389	100

Activities and organizations implemented in experimental processes of the studies were organized 91 different codes and grouped in 10 categories. The codes in *physical needs* categories repeated 59 times and had the highest percentage of 15.17 %. The most repetitive codes in the physical needs category were *consume beverages* (n=16) and *moving freely* (n=12) in classroom.

The highest percentage of this category is 15.17 of all. In physical needs category, mostly encountered codes were permission to *consume beverages* (n=16) and *moving freely* (n=12) in classroom. Examples can be seen below;

> *"Experimental group students were encouraged to bring a bottle of water to lesson and drink it whenever they want without permission."*
>
> *"Before the lesson, experimental group students were said that they could drink water and eat sweets like sugar, chocolate during the lesson. Ventilation of class was cared"*
>
> *"Experimental group students were informed that they were free to drink or eat during the implementation process without permission."*

*Visual material (*14.91%) and *other methods* (14.65%) were the second mostly observed categories in experimental process. The most repeated codes in *visual material* category were using *poster* (n=13) and *picture* (n=10) in teaching techniques. In the *other methods* category, using *drama* (n=8) and *question-answer* (n=7) techniques were the mostly repeated ones during the teaching process. Examples can be seen below;

> *"Concept maps, cartoons, pictures, photos and posters with scientific sentences were prepared on the related topics and hanged on the walls".*
>
> *"A student acted like a tree to show the trade with people and animal as a drama activity."*
>
> *"Each group presented their studies to class, asked question to their friends about the topic and answered the question asked by students. Things learned were repeated with activities like game, drama."*

The frequency of the *learning atmosphere* category was 46, *multi-dimensional evaluation* category was 43 and *technologic material* category was 44. The most frequently repeated codes were; for the learning *atmosphere* category was listening to *music* (n=14) during the lesson and activities to *decrease the stress* (n=11), for the *multi-dimensional evaluation* category were *using worksheets* (n=10) and *concept maps* (n=7), for the *technologic material* category was using *slides* (*PowerPoint*) (n=18). Examples chosen from the studies can be seen below;

> *"While groups are studying, they listened to classical music."*
>
> *"Classical music was used as background music for the experimental group students during the lesson. When experimental group students got bored and their interest decreased, they did body movements as a physical activity"*

The least repeated codes and frequencies in other categories were: *organizing learning environments* (6.94%), *attention/motivation strategies* (5.40%), *and personal differences* (4.63%). In the *organizing learning environments* category was *physical environment of the class* (n=14) and in *attention/motivation strategies* category was informing *about the structure and mechanism of brain* (n=7).

Group study is the least repeated category which was 4.11%. The most frequent code in this category was the *group studying* (n=12) in learning activities.

Discussion, Conclusion and Suggestions

This study aimed to examine the methodological qualities of the experimental studies on the brain-based learning methodologically and determine the learning activities implemented during the experimental process of brain based learning studies in Turkey. The adequacy level of the examined studies was generally fair. The adequacy level of the brain based learning studies in terms of *problem status, aim, data analysis technique selection, presenting the results* and *recommendations* was *fair.* In the studies examined, "selected instruments" and "research design" parts were not the desired level in terms of the determined criteria which is a remarkable result. In terms of research design, there were some deficiencies in 29% of the studies. 15, 9% of the examined thesis and 18, 7% of the articles were poor in terms of data collection category. In the research design category 30, 3% of the examined thesis and 20, 8 % of the articles were evaluated as poor. To sum up, some studies were not adequate in terms of the presentation of research method. In this study, the examined studies were experimental. Experimental studies are conducted to examine the cause-effect relations between the variables under the control of researcher. Variability and reliability of the experimental studies' results are based on the quality of the study. The main aim of this research is to get a real effect of the independent variable (It is the brain based learning for the studies in this research) and able to generalize the findings by providing the repetition of experimental conditions (Büyüköztürk, 2000; Karasar, 2005).In this aspect, it is expected to explain the method and process clearly in order to repeat the researches again and able to generalize the findings in addition to make the research method clean. It was seen that less than half of the examined studies were excellent in terms of the problem status, research design, and data collection process. Although the evaluation level was excellent in the evaluation about the findings, results and recommendations, when the quality of other parts is poor, it is not enough for the quality of the study in general.

The second research problem was to determine the learning environment and the learning activities implemented during the experimental process of "brain based learning studies" Learning activities were grouped into these categories: visual material (14.91%); technologic material (11.31%); physical needs (15.17%); attention/motivation strategies(5.40%); group works (4.11%); personal differences (4.63%); multi-dimensional evaluation (11.05%); other methods (14.65%); learning atmosphere (11.83%); organizing learning environments (6.94%). It was found that the codes in this category differ from each other's learning activities. As the "brain based learning" is not an approach or method which has steps, many kinds of methods and techniques are used in accordance with the recommendations of theorists, there happens interventions to the learning environment and each researcher has their own teaching process with their comments along with the recommendations. Experiment is the process where independent variables affect the dependent ones, systematic changes are done in controlled situations and results are observed(Karasar, 2005). In experimental designs the main factor which determines the cause-effect relation is controlling the variables. The aim of the controlling variable is to increase the internal validity and to provide the result is caused by only tested independent variable (Karasar, 2005). In the examined studies, although the implementation of the "independent variable" which is determined as "brain based learning" differs among the studies, using many different kinds of methods and techniques in one study and interventions to the individuals and learning environment may be "distractive factor" for the examined variables. For example, in the learning environments, learning method variety is expected in accordance with the aims. But, each method (project management, question-answer, simulation, dreaming studies, concept maps, drama) may have different effects on the dependent variables in an experimental research of brain based learning. So, it cannot be possible to examine the cause of "effect". For this reason, in order to provide the internal validity of the experimental researches, it is expected to control external variables. This is possible with the controllable variable numbers. Other conditions should be staying same. Although, there are some difficulties to provide this control in educational studies, it should be tried as far as possible in experimental studies. Considered the differences among the studies, it was seen that internal validity could not be improved.

Artificial experimental environment is created. Environment is organized with an intervention in educational researches. As a result of physical and physiological effects of experimental environment, subjects can show reactions that they do not do under normal conditions. There is no relation between this reaction and the reaction to the independent variable which is wanted to be tested. In this situation called Howtorne effect, as the participants are chosen and tested for the experiment group, research results can be affected when their behaviors changed (Karasar, 2005). With the interventions to the experimental groups of brain based learning studies, there is a possibility of this kind of effect and this situation is an important factor which affects the generalizability of experimental findings.

In this study, it was seen that different kinds of learning approaches, strategies, methods and materials are used in the brain based learning studies. The least used activity in the experiment process is *group working* (4.11%)But in the method parts of the studies, there were not any details about how groups were assigned or how they were organized (homogenous/ heterogeneous). In the experimental process of the studies the most used activity was *physical needs* (15.17%).The main point emphasized by the researches was that allowing students to drink something (water/drinks, 27.11%) and moving freely in the class (20.34 %).

Examined studies are based on the principles and recommendations of the Caine and Caine (1991) about "brain based learning". Caine and Caine (1991) suggest that nutrition, doing sports, relaxing, using different learning ways provide a better learning for brain and these should be done in class learning process. In a humanistic learning environment, it is important to meet the needs of learners. Meeting the physical needs is absolute must for learning rather than an approach proposal and it must be done in every condition. For this reason, instead of evaluating like a learning approach, it should be taken into consideration that it is the basic human need and should be met without dispute.

Considered the results of the examination of brain based learning studies' experimental process, it has been seen that brain based learning does not offer different method, technique and strategies than existing learning theories do. Similarly, Üstünoğlu (2007) stated that it is difficult to differentiate the principles of brain based learning and its and reflections to education than existing ones. So, it can be said that brain based learning consists some of the characteristics of other learning theories and methods. This situation - similarity of brain based learning model with other approaches and theories- has created questions about the originality of the model (Üstünlüoğlu, 2007).

According to Alfering and Farmer-Dougan (2010), our understanding about the working neurons, role of neurotransmitters and the data showing relations between brain efficiency and academic tasks has provided clear clues about how children learn. But the main problem is not only neuroscience data but it is caused by the brain based learning approach writers who filled the gap in this field improperly. So, the problem is not about what neuroscientists and educators know, it is about what they think to know. This "gap-filling "results from many factors such as misunderstanding of the research, misinterpretation or over interpretation of the data, claims without evidence or going beyond the evidence (Alfering and Farmer-Dougan, 2010). Immordino-Yang (2011) also stated that explaining the learning principles just with brain is difficult, environmental stimulants affect learning but they are still inadequate to explain with researches about brain.

To sum up, in order to increase the efficiency of the learning and to create an environment with rich stimulants, it is crucial to benefit from variety of materials and methods. But, it is not appropriate to present the recommendations related to different kinds of model and theories combinations as new and original learning approach. Although it is known that it is difficult to test this method combination experimentally, doing these kinds of research and getting inconsistent results misguide teachers who are the practitioners of this field. In addition, as the educational neuroscience researches (Davis, 2004; Willis, 2008; Immordino-Yang, 2011) state, using brain based learning which has not been supported by brain studies yet and presenting it as it is new and original model may cause ethical problems for students because of implementing variables of which effects are unclear on students.

Kaynakça

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Appendix 1. Rubric for Methodological Analyze

Categories		Items	Level of competency		
			Poor	Fair	Excellent
1	Statement of Research Purpose	1	It is not clear to avoid misunderstandings.	It is not clear enough to avoid misunderstandings.	It is clear to avoid misunderstandings.
		2	Problem is not concretized.	Problem is not concretized enough.	Problem is concretized.
		3	Relations between variables are not clearly questioned.	Relations between variables are not questioned clearly enough.	Relations between variables are clearly questioned.
		4	Operational/functional purposes are not defined.	Operational/functional purposes are not defined enough.	Operational/functional purposes are defined.
2	Problem of the Research	5	Neither hypothesis nor problem and sub problems of research are clearly defined.	Neither hypothesis nor problem and sub problems of research are defined clearly enough.	Both hypothesis and problem and sub problems of research are clearly defined.
		6	Hypothesis or problem and sub problems of research are not overlapped of research scope.	Hypothesis or problem and sub problems of research are not overlapped of research scope exactly.	Hypothesis or problem and sub problems of research are overlapped of research scope.
		7	Hypothesis or problems and sub-problems of research is not appropriate with the aim of the research.	Hypothesis or problems and sub-problems of research do not reflect the aim of the research exactly.	Hypothesis or problems and sub-problems of research is appropriate with the aim of the research.
3	Research Design	8	Research design is not chosen appropriately with research problem.	Research design is not chosen appropriately with research problem adequately.	Research design is chosen appropriately with research problem.
		9	How experiment and control groups are consisted is not explained and they are not consisted appropriate with the aim.	How experiment and control groups are consisted is not explained adequately and they are not appropriate with the aim of research adequately.	How experiment and control groups are consisted is explained with details and they are consisted appropriate with the aim.
		10	Steps of experimental process and process steps are not explained.	Steps of experimental process and process steps are not explained adequately.	Steps of experimental process and process steps are explained.
		11	Process applied to control group is not explained.	Process applied to control group is not explained adequately.	Process applied to control group is explained.
		12	Variables need to be controlled are not controlled.	Variables need to be controlled are not controlled adequately.	Variables need to be controlled are controlled.
		13	Experimental application process time given to observe the effect of independent variable is not enough (in terms of affective features).	Experimental application process time given to observe the effect of independent variable is limited (in terms of affective features).	Experimental application process time given to observe the effect of independent variable is enough (in terms of affective features).
4	Data Collection	14	Data collection tools are not appropriate with the aim of the research.	Data collection tools are not appropriate enough with the aim of the research.	Data collection tools are appropriate with the aim of the research.
		15	Information about the validity and reliability studies of data collection tools are not given.	The validity and reliability studies of all data collection tools are not given enough.	The validity and reliability studies of data collection tools are given (they exceed lower limit decided for validity and reliability in social sciences field).
		16	Information about the ethic permission necessary for collecting data is not given.	Information about the ethic permission necessary for collecting data is not enough.	Information about the ethic permission necessary for collecting data is given.
		17	Data collection process is not explained.	Data collection process is not explained in a detailed way.	Data collection process is explained in a detailed way.

Appendix 1. Continue

Categories		Items	Level of competency		
			Poor	**Fair**	**Excellent**
5	Data Analysis	18	Appropriate techniques are not used for data analysis.	Each technique utilized for data analysis are not used appropriately.	Appropriate techniques are used for data analysis.
		19	Process of the data analysis is not explained.	Process of the data analysis is not explained in a detailed way.	Process of the data analysis is explained in a detailed way.
6	Findings	20	Findings are not based on data of the research.	All findings are not based on data of the research.	Findings are based on data of the research.
		21	Findings are not consisted in a way to answer the research problem and sub-problems and they are not limited with the scope of the problem.	All findings are not given in a way to answer the research problem and sub-problems and limited with the scope of the problem.	Findings are consisted in a way to answer the research problem and sub-problems and they are limited with the scope of the problem.
7	Results	22	Results are not based on findings of the research.	Results don't cover and/or exceed findings of the research enough.	Results cover results of the research and explained in the limits of the research.
8	Recommendations	23	Recommendations are not based on results of the research.	Recommendations don't cover and/or exceed results of the research enough.	Recommendations cover results of the research and explained in the limits of the research.