IMPACTS OF BRAIN-BASED LEARNING ON ACADEMIC ACHIEVEMENT AND ATTITUDE IN GEOGRAPHY TEACHING

(Research Article)

Özlem Yağbasan [a] *, Oğuz Altun [b]

[a] Gazi University, Faculty of Gazi Education, Department of Geography Education, Ankara, 06560, Türkiye
[b] Ankara Atatürk Anatolian Highschool, Ankara, 06560, Türkiye

Abstract

This study was designed to determine the impacts of Brain-Based Learning (BBL) approach on the attitude and academic achievement of 11th grade secondary school students in the geography courses in Yüksekova Anatolian Imam Hatip High School in Hakkari Province in the 2014-2015 academic year. Audio-visual materials, videos and presentations were utilized while designing the classroom environment for the BBL approach. A semi-experimental research design was implemented with the participation of 80 students. The experimental and control groups of the research consisted of 40 students in the 11-A branch, 40 students in the 11-B branch, respectively. The 'Geography Course Attitude and Perception Survey' and 'Achievement Test' developed for this study were applied to both the experimental and control groups as posttests. The data obtained in the research were analyzed with the SPSS 22.0 program. The results revealed that the students of the experimental group had a statistically significant higher mean score than the students of the control group on achievement test and attitude survey, pointing out that the BBL teaching approach had a positive effect on the students' improvement in academic achievement and attitude. In the light of these findings, recommendations were made for the improvement of teaching practices with the use of BBL in designing more efficient teaching practices for the Geography courses in the curriculum.

Keywords: Brain-Based Learning; design of classroom environment; academic achievement; geography education

*Corresponding author (Özlem Yağbasan). ORCID ID.: https://orcid.org/0000-0002-5609-382X
E-mail: ozlemy@gazi.edu.tr

1. Introduction

1.1. Brain-based learning

Education is an important process in the development of societies because it directly affects the lives of individuals and contributes to the formation of the social culture. Due to the conditions of the 21st century, the ease of access to information and its unlimited size for success in education necessitate the change of both education systems and philosophy and other dynamics of education such as students, teachers and teaching processes.

The rapid change and technological developments that societies have experienced in recent years have revealed many innovations and trends in the world of education, and also affect the learning-teaching process, emphasizing the importance of learning rather than teaching. While this perspective in the world of education once again underlines the importance of student-centered approaches, it has also directed the researchers to work on increasing the capacity of the individual learner. In this context, the unknowns about the brain, the hidden world of the brain and the questions about its functions in the learning process have been tried to be elucidated, especially in the light of neuroscience research conducted over the last century.

Therefore, the results of the research conducted by the scientists on the subject have begun to attract the attention of the educators. When these studies on the brain and learning are examined, a learning approach called different names such as "Brain-Based Learning", "Neurophysiological Learning", "Brain Compatible Learning" or "Brain-Based Learning" has been put forward in the literature. Caine & Caine (2002), one of the important theorists of the concept of brain-based learning, define brain-based learning as follows: Brain-based learning is the design and implementation of rich and appropriate experiences for learners, intertwined with life, and ensuring that students understand the meaning and essence of their experiences. Brain-based learning is a detailed teaching approach based on current neuroscience research findings and suggestions on how the brain naturally learns. It involves accepting the brain's functioning rules for meaningful learning and organizing teaching according to these rules in the mind.

Brain-based learning is designed to ensure that learning and teaching environments in the education world comply with the working principles of the brain. It has begun to be accepted as one of the important learning approaches. There are many studies conducted around the world within the framework of this theory (Caine & Caine, 1990; Pinkerton, 1994; Caine & Caine, 1995, Jensen, 2000; Weiss, 2000; Prigge, 2002; Roberts, 2002; Bellah et al. 2008; Sousa, 2011; Kapadia, 2014; Waree, 2017; Godman, 2019; Lagoudakis et al., 2022). In parallel with this, the research on the effects of the brain-based learning approach on students' course achievement, permanence of knowledge and attitudes towards the course is increasing in our country has started (Çengelci, 2007; Gülpınar, 2005; Erduran Avcı & Yağbasan, 2008; Özden & Gültekin, 2008; Baş, 2010; Duman, 2010; Şeyihoğlu & Yarar Kaptan, 2012; Gözüyeşil & Dikici, 2014; Şenel Çoruhlu, et al., 2016; Ekemen & Beyhan, 2020).

1.2. Brain-based learning and geography education

Geography courses aim to introduce the universe we live in, the world, our country and our environment, and also to teach the distribution of natural and human events on earth and their relationships with each other, adhering to the basic principles of Geography. While doing this, one of the most important sub-goals of Geography is to raise individuals who research, ask and question with modern educational approaches. In addition to providing general skills such as critical thinking, problem solving, creative thinking, communication and empathy, decision making, and the ability to use information technologies, Geography courses also include map skills, observation skills, field work skills, geographical inquiry skills. It also helps to develop the skills of preparing and interpreting diagrams, the ability to perceive time, the ability to perceive change and continuity, and the skills of using evidence. In Geography courses, an educational environment is created for the students where geography knowledge will make life easier, change their perspective on society and the environment, and use the geographical knowledge obtained in all spaces (Altun, 2017).

According to the traditional approaches, based on a teacher-centered understanding in the education-training processes, the teacher has a role of directly transferring information to the student. However, in recent years, this approach has been replaced by the constructivist approach, in which the learner and the teacher structure the knowledge together, also the knowledge is discovered, interpreted and new information is revealed by the learner. This approach in geography teaching should be carried out as a process in which the student is at the forefront, decisions are made together by the learner and the teacher, social interaction is ensured, and measurement and evaluation are made not only for the exam but also for what the student produces.

Besides, active learning in geography teaching is very useful because it can be used not only at a certain level and in a certain subject, but in almost every subject and at every level, provides the ability to use the information in various ways and the opportunity to foresee the results. In addition to knowing and applying these approaches, the Brain-Based Learning (BBL) approach, which is thought to provide permanent learning in many fields, including geography teaching, is also gaining increasing importance.

BBL approach focuses on the learner, evaluates his/her affective, cognitive and psychomotor skills, aims to prepare appropriate physical environments for learning and individualize teaching. The Geography course, which will be conducted in accordance with brain-based learning, will positively affect the personal and social development of the individuals. The reason is both that one of the sub-goals of Geography is to understand and make sense of the world and that the brain-based learning approach is a learning method that directs the individual to discovery, curiosity and critical look.

This study is important in terms of contributing to the research on brain-based learning in our country. The general purpose of the study is to evaluate the impacts of the Geography

course prepared based on brain-based learning approach on the students' academic achievement and attitudes. In line with this general purpose, answers were sought to the following sub-problems (Altun, 2017):

1. Is there a significant difference between the achievement posttest scores of the students studying in the environments designed for the brain-based learning approach and the students studying in the traditional classrooms?

2. Is there a significant difference between the attitude posttest scores of the students studying in the environments designed for the brain-based learning approach and the students studying in the traditional classrooms?

2. Method

2.1. Research design and sampling technique

This research was designed according to the semi-experimental research design in order to determine the effectiveness of the experimental process performed. In the study, the experimental and control groups are similar to each other and randomly selected and the research pattern is organized as a semi-experimental pattern (Büyüköztürk et al., 2018).

The experimental and control groups in this study were determined to test the effectiveness of course teaching with brain-based learning approach on attitude and academic achievement of 11th grade secondary school students in the Geography courses in Yüksekova Anatolian Imam Hatip High School in Hakkari Province in the 2014-2015 academic year (Altun, 2017). A semi-experimental research design was implemented with the participation of 80 students. The experimental and control groups of the research consisted of 40 students in the 11-A branch, 40 students in the 11-B branch, respectively.

Audio-visual materials, videos and presentations were utilized while designing the classroom environment in implementing the BBL approach. While the course was taught with BBL approach in the experimental group, traditional teaching method was performed in the control group. The dependent variable of the research is the attitude and academic achievement of the students, and the independent variable is the course taught using BBL approach and the traditional teaching method.

2.2. Data collection instruments and the process

The data collection tools used in the research are achievement test and attitude and perception survey (Altun, 2017). The preparation of the academic achievement test from the 'Let's Get to Know Countries' section of the 'Global Environment: Regions and Countries' unit in the 11th Grade Geography course in secondary education was carried out in the following stages:

First, the subject headings of the unit and the achievements in these subjects were determined. These achievements are:

11.2. It relates raw materials, production and market areas to trade between countries and regions.

11.4. It investigates the geographical characteristics of a country through a case study.

11.6. Interprets the agriculture-economy relationship by comparing countries at different levels in terms of agricultural activities.

11.7. Evaluates regional and global organizations in terms of their purposes, functions and areas of influence.

For this purpose, the 11th grade Geography course curriculum prepared by the Ministry of National Education was used (MEB, 2011). After the achievement test was applied to the experimental and control groups, item and test analyzes were conducted on the test items (Altun, 2017). The discrimination power and item difficulty of each question were calculated. 6 questions were eliminated after the detailed evaluation of the specialists in their fields (2 academicians, 2 geography teachers and 1 assessment and evaluation expert working in the Ministry of Education).

The application started on 02.03.2015 and lasted a total of 10 course hours in 5 weeks, 2 hours a week, excluding the hours allocated for the achievement test and attitude and perception survey. The application was carried out by the researcher in both the experimental group and the control group. In the control group; no materials other than the student textbook, student workbook and Turkey Regions map were used. The teaching process was completed by following the Practitioner Teacher Guide Book. Text readings from the textbook, activities in the student workbook and evaluation questions at the end of the unit are included in the course plan. The course was taught mostly through discussion and question-answer techniques with the students.

In the experimental group, the students were relieved of the fear of the grades and exam stress by telling students that no grade will be given at the end of the study. The students were warned before the application to bring water and sweet foods with them, and they were told that they could easily eat the food they brought during the course. It is said that the students can also move freely in the course, and the environment has been designed accordingly. Also, special care was taken to ensure that the classroom was ventilated. The teaching activities were sometimes carried out individually and sometimes in groups.

Since there was no computer in the classroom, the course was taught using a personal computer that was usually brought by the teacher. The visual materials related to the topics covered were hung on the walls and remained there until the next topic. In the first course, the structure of the brain was introduced to the students and the answer to the question of why we can learn more easily if we know the brain was taught. The visual materials, presentations, videos, worksheets accompanied by classical music, and the physical activities were used in

all courses with BBL. The course plans were prepared for the brain-based learning approach in detail. One of the course plan and the teaching-learning activities is given in Table 1:

Course Plan

Images: Images from England are used.

Presentations: 'England' presentation is used.

Worksheets: The puzzles about England are used.

Music: Beethoven's Piano Sonata No.20 in G major, Op.49 No.2 is used as classical music.

Movement: The students perform movements that exercise their neck, waist, hand and arm muscles under the guidance of the teacher. The students drink some water after the exercises.

Evaluation activity: The students are given an achievement test about England that can measure what they have learned as an evaluation activity.

Table 1. Teaching-learning activities

Teaching-learning activities	Verbal-linguistic	England's industrialization process will be explained. Reading texts related to the subject are explained.
	Naturalist	Natural environmental features of England are explained. The effects of the natural environment on the industrialization process are explained.
	Social-interpersonal	A group of students undertakes the presentation of England. After the introduction, the topic is intensified by a round of questions.
	Logical-mathematical	Important milestones from the point of industrial development are determined. The time period determined by each turning point is expressed with certain themes. Generalizations are made by determining the characteristics and developments of each period.
	Internal-individual	The question is asked: What development factors do you think the dimensions that contemporary industry has reached today are based on?
	Visual-spatial	Presentation demonstration on the topic. Virtual flights over England are made with the Google Earth program. A timeline is made regarding the development of the industry.
	Physical-kinesthetic	Information, emotions and thoughts are expressed through facial expressions and behaviors.

The remaining five course plans used in the courses, attitude and perception survey and the worksheets prepared in accordance with the brain-based learning approach in teaching geography courses are included in the thesis (https://tez.yok.gov.tr/UlusalTezMerkezi/tezDetay.jsp?id=pqkd88aI_UahZrxjBKMB-Q&no=gsnbScIrmwNn90mnwilcGA).

Finally, the posttest was applied to the students after the explanation of the subjects in the courses. The impacts of the courses taught on attitude and academic achievement in the experimental and control groups were tried to be revealed with the posttest. 'Geography Course Attitude and Perception Survey' and 'Achievement Test' were applied as posttest to both groups.

2.3. Data analysis

SPSS (Statistical Package for the Social Sciences) was used for the data analysis in the research (IBM SPSS Statistics (Version 22). In interpreting the research results, arithmetic mean (X) and t-test for dependent and independent groups were used to determine the differences between and within groups from statistical procedures. The pretest could not be applied in the research due to lack of resources (Altun, 2017). In many applications, pretesting is either impossible or unnecessary (Karasar, 2023). Essentially, this research is similar to an uncontrolled posttest model because the efficiency of a method compared to others is not tested on different groups.

Initially, Shapiro-Wilk test was performed to analyze whether the groups showed normal distribution or not. The Shapiro-Wilk test is a statistical test of the hypothesis that the distribution of the data as a whole deviate from a comparable normal distribution (Shapiro & Wilk, 1965). If the test is non-significant (p>. 05) it tells us that the distribution of the sample is not significantly different from a normal distribution. Shapiro-Wilk test results of the research are given in Table 2.

Table 2. Shapiro-Wilk test results

	Control group		Experimental group	
	N	P	N	P
Achievement posttest	40	0,095	40	0,066
Attitude posttest	40		40	

When Table 2 is examined, it is seen that all variables belonging to the posttest scores of the students in the experimental and control groups show normal distribution. In this case, it is possible to analyze the data with both correlated and unrelated t-test.

3. Results, Discussion and Conclusion

The first sub-objective of the research was stated as "Is there a statistically significant difference between the achievement posttest scores of the students studying in the classrooms designed in accordance with the brain-based learning approach and the students studying in the traditional classrooms?".

In order to determine whether there is a statistically significant difference between the scores of the students in the experimental and control groups from the achievement posttest, t-test was conducted to the results of the achievement tests of the students in the experimental and control groups. The results are given in Table 3.

Table 3. Unrelated samples t-test results of the comparison of the achievement posttest scores of the experimental and control groups

Group	N	Average	Standard Deviation	t	p
Experimental	40	53,1	8,35		
Control	40	23,2	6,79	17,57	0,00

When Table 3 is evaluated, it is seen that there is a statistically significant difference between the achievement posttest scores of the experimental and control group students ($p=0,000<0,05$). While the average of the achievement posttest scores of the experimental group was 53.1, the average of the control group achievement posttest scores was 23.2. This difference was found to be statistically significant in favor of the experimental group.

The results show that the experimental process applied is effective in increasing students' achievement levels. In other words, in teaching the students about 'Let's Get to Know Countries' section of the 'Global Environment: Regions and Countries' unit in the 11th Grade Geography course, explanation of the course with brain-based learning approach is an effective method in increasing the students' achievement.

The second sub-objective of the research was identified as "Is there a statistically significant difference between the attitude-related posttest scores of the students studying in the environments designed in accordance with the brain-based learning approach and the students studying in the traditional classrooms?".

The t-test was implemented to the results of the attitude tests of the students in the experimental and control groups in order to determine whether there is a statistically

significant difference between the scores of the students in the experimental and control groups from the posttest on attitude. The results are given in Table 4.

Table 4. Unrelated samples t-test results of the comparison of the achievement posttest scores of the experimental and control groups

Group	N	Average	Standard Deviation	t	p
Experimental	40	3,23	0,35		
Control	40	2,90	0,41	3,85	0,00

When Table 4 is analyzed, it is observed that there is a statistically significant difference between the attitude posttest scores of the experimental and control group students (p=0,000<0,05). While the average of the attitude posttest scores of the experimental group was 3,23, the average of the control group attitude posttest scores was 2,90. This difference was found to be statistically significant in favor of the experimental group. According to the result, the brain-based teaching approach applied for the experimental group and the required environment design are superior in positively affecting the students' attitudes towards the course compared to the traditional teaching method and the traditional classroom environment applied for the control group.

In line with the previous studies conducted in the literature examining the effect of the brain-based learning approach on academic achievement (Ozden & Gultekin, 2008, Duman, 2010; Şeyihoğlu & Yarar Kaptan, 2012, Gözüyeşil & Dikici, 2014; Şenel Çoruhlu, 2016; Waree, 2017, Lagoudakis et al., 2022), this study demonstrates that brain-based learning helps to increase students' achievements and their attitudes towards the course. The results of the study also show that the experimental process applied is effective in increasing students' achievement levels and their attitudes towards the course.

As a summary, supporting the course process with the elements that make the students' brains more active, implementing in-class activities by designing environments in which the students learn with pleasure, having fun and willingly, has been effective in increasing the course success of the experimental group students of the Geography course education based on the brain-based learning approach. In addition, it is thought that the teaching, methods and techniques used in the brain-based learning approach during the experimental process, course activities, materials used, ensuring the active participation of students in the course and the classroom atmosphere that reveals the existing potential of the students and provides the opportunity to show their potential positively increased the success of the course.

It is a common view that the students' achievement in a course is generally related to the positive or negative attitudes they are thought to have developed towards that course. In this research, while planning the teaching activities based on the brain-based learning approach, an attempt was made to ensure that students make strong emotional connections. In addition, it is thought that the teaching materials such as visual products, presentations, videos, animations, worksheets and documents, etc. used in the courses have an increasing effect on the students' attitudes towards the course, and these opportunities increased the students' curiosity, interest and motivation positively in the course.

Finally, it has been determined that the brain-based learning approach increases students' academic success, provides meaningful and permanent learning, and positively affects students' attitudes towards the course, especially when enriched learning environments are created. It is clear that the studies in this field in our country will provide significant benefits to both teachers and the students.

Considering the findings obtained from the research, the following *suggestions* are presented:

- Brain-based learning principles provide important clues about organizing the learning-teaching process. In line with these principles, the parallel processor feature of the brain should be utilized through the presentations and activities that engage the students' multiple sensory organs and positive emotions. By taking into account the impact of the students' physiological state and needs on the process, the negative effects of the factors such as stress, fatigue, hunger and thirst should be eliminated, and the students should be enabled to learn with appropriately challenging learning activities by using their spatial memory.

- The course environments must be designed precisely according to the understanding of the brain-based learning approach. Also, it should not be forgotten that the planning and organization of BBL courses on a daily basis and in-class activities is a quite hard and time-consuming process.

- While planning the brain-based learning activities, the practices that enable the students to use their holistic brain functions should be included. In this context, visual, auditory and kinesthetic activities should be performed effectively. Also, the students should have high motivation, strengthened positive emotions and full self-confidence during the brain-based learning course activities.

- Brain-based learning approach can be integrated into the education programs. The courses can be supported with various applications both in in the classroom and the field.

- Pre-service and in-service training for the brain-based learning approach should be provided for the teachers by the Ministry of National Education and General Directorates of National Education.

- The educational studies should be carried out to enable teachers to learn and use the learning techniques of the brain-based learning approach. It is essential to encourage teachers with the implementation of BBL projects into their course plans.

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Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest.

References

Altun, O. (2017). Coğrafya öğretiminde beyin temelli öğrenmenin akademik başarı ve tutuma etkisi [Impact of brain-based learning to academic success and attitude in geography teaching]. (Unpublished master's thesis). Gazi University, Institute of Educational Sciences, Ankara.

Baş, G. (2010). Beyin temelli öğrenme yönteminin İngilizce dersinde öğrencilerin erişilerine ve derse yönelik tutumlarına etkisi [Effects of brain-based learning on students' achievement levels and attitudes towards English lesson]. *İlköğretim Online*, *9*(2), 488-507.

Bellah, K. A., Robinson. J. S., Kaufman, E. K., Akers, C., Haase-Wittler, P. & Martindale, L. (2008). Brain-based learning: a synthesis of research. *North American Colleges and Teachers of Agriculture (NACTA)*, *52*(2): 15-22.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2018). Eğitimde bilimsel araştırma yöntemleri [Scientific research methods in education]. *Pegem Akademi, Ankara*. ISBN: 978-9944-919-28-9, **http://dx.doi.org/10.14527/9789944919289**

Caine, R. N., & Caine, G. (1990). Understanding a brain based approach to learning and teaching. *Educational Leadership*, *48*(2), 66-70.

Caine, R. N. & Caine, G. (1995). Reinventing schools through brain-based learning. *Educational Leadership*, *32* (7), 43-48.

Caine, G., & Caine, R. N. (2002). Making connections: teaching and the human brain (trans. G. Ülgen*). Ankara: Nobel Yayıncılık*.

Çengelci. T. (2007). The effect of brain-based learning to success and retention in social studies. *Elementary Education Online*, *6*(1), 62-75.

Duman, B. (2010). The effects of brain-based learning on the academic achievement of students with different learning styles. *Educational Sciences: Theory and Practice*, *10*(4), 2077-2103.

Ekemen, H., & Beyhan, Ö. (2020). The effect of brain based learning on academic achievement and students' attitude in Turkey: A meta analytical study. *Research on Education and Psychology (REP)*, *4* (Special Issue), 18-33.

Erduran Avcı, D. & Yağbasan, R. (2008). Beyin yarı kürelerinin baskın olarak kullanılmasına yönelik öğretim stratejileri [Teaching strategies for dominant use of brain hemispheres], *Gazi Eğitim Fakültesi Dergisi*, *28*(2), 1-17.

Godman, T. H. (2019). Principals' perceptions of brain-based learning. (Unpublished PhD thesis), Columbus State University, USA, Theses and Dissertations. 315. https://csuepress.columbusstate.edu/theses_dissertations/315

Gözüyeşil, E., & Dikici, A. (2014). Beyin temelli öğrenmenin akademik başarıya etkisi: bir meta-analiz çalışması [The effect of brain-based learning on academic achievement: a meta-analysis study]. *Kuram ve Uygulamada Eğitim Bilimleri, 14*(2), 629-648.

Gülpınar, M. A. (2005). The principles of brain-based learning and constructivist models in education. *Educational Sciences: Theory & Practice*, *5*(2), 299-306.

Kapadia, R. H. (2014). Level of awareness about knowledge, belief and practice of brain based learning of school teachers in Greater Mumbai region. *Procedia - Social and Behavioral Sciences*, *123*, 97-105.

Karasar, N. (2023). Bilimsel araştırma yöntemi: Kavramlar, ilkeler, teknikler [Scientific research method: Concepts, principles, techniques]. *Nobel Akademik Yayıncılık*, 38th Edition, 368 pp., ISBN: 978-605-5426-58-3

Jensen, E. (2000). Brain-based learning: a reality check. *Educational Leadership*, *57*(7), 76-80.

Lagoudakis, N., Vlachos, F., Christidou, V. & Vavougios, D. (2022). The effectiveness of a teaching approach using brain-based learning elements on students' performance in a Biology course. *Cogent Education*, *9*:1, 2158672, **http://doi.org/10.1080/2331186X.2022.2158672**

MEB (2011). Coğrafya Dersi Öğretim Programı, CDÖP [Geography Course Curriculum] MEB Talim ve Terbiye Kurulu Başkanlığı [Ministry of Education Training and Training Board], Ankara.

Ozden, M. & Gultekin, M. (2008). The effects of brain-based learning on academic achievement and retention of knowledge in science course. *Electronic Journal of Science Education*, *12*(1).

Pinkerton, K. D. (1994). Using brain-based learning techniques in high school science. *Teaching & Change*, *2* (1), 44-60.

Prigge, D. J. (2002). 20 ways to promote brain-based teaching and learning. *Intervention in School and Clinic*, *37*(4), 237-241.

Roberts, J. W. (2002). Beyond learning by doing: The brain compatible approach. *The Journal of Experiential Education*, *25*(2), 281-285.

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, *52*(3-4), 591-611. **http://doi.org/10.1093/biomet/52.3-4.591**

Sousa, D. (2011). Mind, brain, and education: The impact of educational neuroscience on the science of teaching. *Learning Landscapes*, *5*(1), 37-43.

Şenel Çoruhlu, T., Er Nas, S. & Keleş, E. (2016). Beyin temelli öğrenme yaklaşımına dayalı web destekli öğretim materyalinin etkililiğinin değerlendirilmesi: ışık ve ses ünitesi [Evaluation of efficacy the web based instructional material prepared according to brain

based learning approach: "light and sound" unit]. *Amasya Üniversitesi Eğitim Fakültesi Dergisi*, *5*(1), 104-132.

Şeyihoğlu, A., & Yarar Kaptan, S. (2012). Beyin temelli öğrenme yaklaşımının sınıf öğretmen adaylarının coğrafya dersindeki tutum ve başarılarına etkisi [The effect of the brain-based learning approach on the attitudes and success of primary school teacher candidates in geography course]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *42*, 380-393.

Waree, C. (2017). An ıncreasing of primary school teachers' competency in brain-based learning. *International Education Studies*, *10*(3), **http://doi.org/10.5539/ies.v10n3p176**

Weiss, P. R. (2000). Emotion and learning. *Training & Development*, *54*(11), 44-48.

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