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Building executive function with technological support: Brain-based teaching strategies

Rukminingsih & Januarius Mujiyanto
Universitas Negeri Semarang

Joko Nurkamto
Universitas Sebelas Maret

Rudi Hartono
Universitas Negeri Semarang

ABSTRACT: This study investigated the difference effect of implementing brain-based teaching (BBT) by building executive function (EF) with technology support. A quantitative research design with factorial 2x2 was applied, then two classes involving 38 students of a private college in Indonesia in the fourth grade were chosen as the sample. The instruments used were a questionnaire and a test. Two-way ANOVA was applied to analyze the data. The findings showed that (1) there was distinct impact between experimental class and control class in students' reading achievement, (2) the achievements of the students in the Reading course with high motivation were higher than those with low motivation and (3) there was an interaction between teaching strategies and the level of students' motivation in EFL reading achievement. Educators of ELT have to integrate BBT and EF for the meaningful learning further research and development on different brain-based teaching strategies is suggested.

Keywords: brain-based teaching, executive function, students' motivation level, reading comprehension.

1 INTRODUCTION

Educators have many problems during the COVID-19 Pandemic. They must hold their class full online. They cannot meet their students face-to-face. The teaching and learning processes sometimes have many distractions which are caused by some factors. Students often feel frustrated with fully online learning. Many educators just give many tasks to students without paying attention to the way students learn. As educators, they have to know how learning occurs in students' brains to maximize the learning process (Caine & Caine 1990, 2012; Jensen & Sausa 2001). To reach the optimum teaching process, brain-based teaching strategies by building executive function with technological support was implemented in this study. The executive function is used to actively control the emotions, feelings and actions of students. The executive function influences learning by allowing the students how to organize, manage time and plan in their learning activities. Brain-based teaching strategies by building executive function in this study was implemented by creating a positive environment in the online classroom.

Some studies conducted found that a brain-based learning approach helps teachers to find the way they should teach their students. The emotional basis is the core of the learning process (Rukminingsih 2018; Parr 2016; and Salem 2017) (García et al. 2014). It was also found that certain learning processes, including inferencing and combining prior knowledge with text information during reading, are required to understand the text. Executive function is the management system of the brain. It is associated with students' academic achievements. Some studies dealing with building

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executive function found that executive function and the neural network in the brain system can improve the student achievement and motivation (Jacob & Parkinson 2015; Zewelanji et al. 2016; Chevalier et al. 2015).

Therefore, the purpose of this study is to investigate if brain–based teaching strategies by building executive function with technological support can be considered a useful and meaningful learning environment in online learning that could support their reading achievement. This research enables educators and researchers to understand how the student's brain works and learns by building their executive function to contribute to English language learning, especially in EFL reading courses. In addition, we can have a better picture of how foreign language learners can improve and motivate themselves during full online learning, especially in terms of reading courses. Researchers and educators will be able to understand and improve the executive function of students with this knowledge, relevant and innovative pedagogical ideas or teaching methods that allow effective use of brain-based teaching strategies for the achievement of EFL reading. The research questions of this study are:

1. Is there a distinct impact between students who are taught by brain-based teaching strategies by building executive function with technology support with students who are taught by conventional class in students' EFL reading achievement?
2. Do the achievements of students with high motivation in the EFL reading course get higher than those with low motivation?
3. Is there an interaction between teaching strategies and the level of students' motivation in students' EFL reading achievement?

2 LITERATURE REVIEW

2.1 *Brain-based teaching strategies*

Based on some studies above, educators should choose appropriate teaching strategies to cultivate students' motivation. Brain-based teaching strategies by building executive function with technology support can stimulate the students' brain work to learn EFL reading comprehension. Educators in the pandemic COVID-19 era face many problems in teaching by distance education. Brain based teaching is understanding the principles of brain-based learning which involve three instructional techniques which can be implemented in the classroom (Caine & Caine 1994). Three instructional techniques associated with brain-based learning involving orchestral immersion which builds a learning environment which fully engaged students in the class; relaxed alertness which removes fear in the learners while they are learning; and active processing which lets the learners combine and assume materials by actively practicing them (Caine and Caine 1990; Caine et al. 2016).

Students' brains work properly in multifaceted experiences. They need to have various tasks and also teaching strategies. According to Caine and Caine (1994), the brain is unique, learning is changing because it is changing in the brain. To change in long term memory, the brain needs experiences that support the changes which occurred. Those kinds of multifaceted experiences include multisensory input, rewards and motivation, prior knowledge, some examples from concrete to abstract, more practice, telling stories and using computers and other forms of technology. The brain works effectively by seeking the patterns that humans store in their brain by mapping and chunking the information. The information is stored in our brains as patterns. Chevalier (2015) stated keeping the information preserved in the brain is the only way to identify patterns. Teachers need to take fresh data, help students "see" the patterns, associate those patterns with older brain patterns, and generate new ones.

Brain–based teaching strategies generate some meaningful learnings which support the brain work well. Every student has various meaningful learning. What is meaningful to students can be very different from what is meaningful to teachers. Relational memory happens when students are able to connect new learning to something that has occurred in their lives previously. The inclusion of previously stored and mastered patterns or charts makes learning even easier (Willis 2006).

Teachers should provide an environment which lessens stress. A positive classroom environment leads the students to feel safe and comfortable. Lowering stress increases learning. Stressed brains don't learn in the same way as brains that aren't stressed. Students who feel they excel in an area at school will feel better about themselves, and their brains will release chemicals that make them feel good, like dopamine and serotonin, rather than the stress chemical cortisol. Cortisol is elevated by stress, but the amount of cortisol is not specifically related to the effects of memory stress. This means that if students get stress in their learning process, their cortisol will be increased (Shields 2017).

2.2 *Executive function with technology support*

Executive function is a top-down monitoring and control process which activates the learners' behavior (Diamond & Ling 2016). Inhibition (control of one's actions, attention, thoughts and emotions), working memory (temporarily retaining and using information) and cognitive flexibility (effectively switching between tasks) are the key executive functions (Diamond & Ling 2016; Miyake et al. 2000; Zelazo et al. 2013). Another brain-based teaching strategy is building students' executive function. The executive function is an extraordinary capacity to control the emotions, feelings and behaviors of humans actively in order to accomplish goals.

Neuroscience helps the educators' understand the students' brain work, their strengths and weaknesses so it can help teachers understand them. The brain is plastic and can be formed, altered and activated. Research has shown that when students realize and believe that they can change their brains and grow their intellect, they work harder, persist through difficulty and attain greater achievement. (Rukminingsih 2018 and Parr 2016). Brain based teaching strategies to help build executive function developed by Caine & Caine (1990, 2012), Jensen (1996), Sousa (2001) and Chevalier (2015). Certain areas of the brain can be developed by activating students' executive function which are responsible for working memory and emotional control.

As the brain grows and develops, it is ready for various kinds of learning. Their brains have adapted quite well to the high-tech world, and pandemic COVID-19 forces the education to implement full online learning. The use of technology is implemented in all schools in Indonesia. Adult learners utilize inhibition to rally their attention with various tasks in various online platforms both synchronous and asynchronous such as using Google classroom, telegram and zooming. Working memory involves the collection and retrieval of information at the same time. In reading comprehension, for instance, students have to trigger the content schemes of students on the same topic with the text they read, bring context knowledge to the forefront of their memory, use all the details to easily understand the text. Cognitive versatility allows students to support active learning. Cognitive flexibility enables students to make agreement with the teacher or lecturer in their classroom activities while course outline is made (Zewelanji 2016, and Chevalier 2015)

3 RESEARCH METHOD

This study was quantitative factorial because it had two factors and each factor had two levels, participants 2×2 factorial design (Ary et al. 2010). The sample was taken from students who were taking Critical Reading course from two different classes of an English department in one of private college in Indonesia. The participants were 76 students involving 38 students for the experimental group and 38 students for the control group. There are three variables in this study, namely two independent variables (brain-based teaching strategies by building executive function with technology support and online instruction with flipped classroom as a conventional teaching strategy. Then the moderator variable was students' reading motivation and the dependent variable was students' reading achievement.

The instruments used in this study were motivation reading questionnaire and reading comprehension test. The questionnaire was used to measure students' reading motivation level to classify students into high and low levels of reading motivation. The questionnaire with Likert scale in

which the questionnaire was designed with related indicators of students' reading motivation. The reading motivation questionnaire aimed to classify students with high and low levels of reading motivation. Reading comprehension test was used to assess students' achievement in EFL reading comprehension. Two-way Analysis of Variance (ANOVA) at the level of significance alpha = 0.05 was the data analysis used in this study. It was used to test the three hypotheses. There were two assumption requirement of the two-way ANOVA, namely the normality and homogeneity of the test should be met. Normality was evaluated using the Lilliefors test and homogeneity was tested using the F test and Barlet test.

4 FINDINGS AND DISCUSSION

The findings are presented in two sections to answer the research questions. First, the summary of data description is presented in Table 1 and the second, Summary on calculation result of two -way ANOVA data is presented in Table 2.

The following is the summary of the two-way ANOVA computation which contained the variance related to the score of means, teaching strategies, students' motivation, interaction, error, and means

Table 1. Summary of data description.

Statistical Values	A1	A2	B1	B2	A1B1	A1B2	A2B1	A2B2
N	38	38	38	38	19	19	19	19
Highest score	37	34	93	71	37	29	33	29
Lowest score	20	20	20	20	20	20	20	20
Mean	28.08	26.89	81.63	63.68	31.63	24.58	26.58	25.58
Median	28.00	27.50	80.00	64.50	31.00	25.00	26.00	26.00
Mode	28.00	28.00	76.00	64.00	30.00	27.00	32.00	29.00
Standard deviation	4.54	4.09	5.62	4.39	2.73	3.06	4.35	3.06
Variance	20.57	16.69	31.59	19.25	7.47	9.37	18.92	7.37

Notes:
A1: group of students taught by using brain-based teaching strategies by building executive function with technology support
A2: group of students taught by using online instruction integrated with flipped classroom
B1: group of students with high motivation
B2: group of students with low motivation
A1B1: group of high motivation taught by using brain -based teaching strategies by building executive function with technology support
A1B2: group of low motivation taught by using brain -based teaching strategies by building executive function with technology support
A2B1: group of high motivation taught by using online instruction integrated with flipped classroom
A2B2: group of low motivation taught by using online instruction integrated with flipped classroom

Table 2. Summary on calculation result of two-way ANOVA.

Variance	**Dk (Df)**	**Sum of squares**	**Mean square**	**F observed**	Ft A(α) = 0.05
Teaching strategies	1	308	308	28.12	3.88
Students' motivation	1	78	78	7.82	3.88
Interaction	1	174	174	15.22	3.88
Error	72	812	11.27	–	–
Means of treatment	1	557155	–	–	–
Total	76	57155	–	–	–

of treatment. By looking at this description of the analysis of variance, it is easier to take into account the analysis related to two-way ANOVA as shown in the following.

This description of the two-way ANOVA measurement results was used to validate or identify the research hypotheses. The table above described the result of the testing hypothesis. Based on the data on the table above, it was concluded that the alternative hypotheses were confirmed.

The value of observed F exceeds the value of F from table in the three variances (teaching strategy (28.12), motivation (7.82), and interaction (15.22) whereas the value of F from table was merely 3.88 for three variances. It could be seen that the three hypotheses were confirmed at alpha 0.05, as the first hypothesis is that the students' achievement in reading comprehension taught by using brain-based teaching strategies by building executive function with technology support was higher than those taught by using online instruction integrated with flipped classroom strategy was confirmed; the second hypothesis is that the achievements of the students in the reading course with high motivation were higher than those with low motivation was confirmed; the third hypothesis is that there was an interaction between teaching strategies and the level of students' motivation in EFL reading achievement was confirmed.

Based on the finding, it can be concluded that students' achievement in Reading Comprehension by employing brain-based teaching strategies by building executive function, there is a great increase in conceptual understanding after the implementation of online based- instruction based on brain-based teaching in Reading comprehension class. Pourhossein (2014) and Chevalier (2015) stated that using technology can create a learning atmosphere centered around the learner rather than the teacher that in turn creates positive changes. Caineet al. 2016; Rukminingsih 2018; and Zewelanji 2016) have stated that building executive function can lead the students to change their brains and grow their intelligence. They work harder, increase their spirit and make greater achievement in their reading comprehension.

The strategies of brain-based teaching by building executive function with supporting technology involve: (1) creating a positive emotional environment in online classroom, (2) providing opportunities to apply learning, (3) introducing activities to support developing executive function and prior knowledge activation and transfer opportunities and (4) employing model higher thinking skill which adapted from Caine et al. 2016; Sousa 2001 and Handayani et al. 2020.

By employing online instruction, such as in Google classrooms, teachers can use feedback loops to find out whether the students' perception matches their expectation. This step is used to organize information in the brain at different levels. Students must transform information as their own learning with the use of working memory and prior knowledge to form long-term allow students to use the information into different products that can become a trigger for conceptual understanding. Handayani et al. (2020); Ramakrishnan andAnnakodi (2013) and Rukminingsih (2018) found that teachers should make use of brain-based teaching strategy and the concept of brain-based learning in the classroom.

5 CONCLUSION

Based on findings and discussion that brain-based teaching by building executive function had a statistically significant influence on the students' reading achievement and motivation. Based on finding and discussing, brain-based teaching strategies by building executive function with technology support had three conclusions. The students' achievement in reading comprehension taught by using brain-based teaching strategies by building executive function with technology support is effective. There is a statistically significant influence on the students' motivation and achievement in Reading comprehension. There is an interaction between teaching strategy and students' motivation level in reading comprehension.

The findings of this study confirms existing empirical evidence dealing with brain-based teaching strategies which have been implemented by building students' executive function with technological support in one of private college EFL students in Indonesia. These findings have the following pedagogical implications for current and prospective English teachers and lecturers, students and

educational authorities it is great significance that to provide teachers and lecturers with some knowledge in which they can make the students motivated and get a good achievement in full online learning by considering how their brains work and learn by implementing brain-based teaching strategies. Building students executive function stimulates students to have good emotion, positive climate in an online class environment and strengthen their cognitive skills especially in EFL reading courses. In foreign/second language learning, there is an increasing need to understand more about brain-based teaching strategies; therefore, it is hoped that this research will contribute to the further knowledge about students in EFL reading classrooms and facilitate more studies on brain-based teaching strategies with technological support.

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