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The Impact of EFL Learners' Brain Dominance on their Vocabulary Achievement

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Abstract

Over the recent years, following a tremendous interest of studies of specialization of the cerebral hemispheres, there has been an increasing tendency toward the concept of brain dominance preference. This study aimed at investigating the effect of EFL learners' brain dominance on their vocabulary achievement. In addition, due to the important role that gender may play in the process of language learning, the potential role of gender in vocabulary achievement was also investigated. 50 participants of this study were selected through a proficiency test which was administered among 86 male and female EFL learners in Navid Language Institute in Shiraz. The proficiency test was administered for homogenizing the participants. In addition, the learners' vocabulary scores were stored to be compared with the results obtained from the posttest. The selected participants were assigned to three groups according to the results obtained from performing the Brain Dominance Inventory (Davis, Hafsah, and Ruru, 1994). The results of the Inventory showed that 18 participants (36%) were left-brained, 23 participants (46%) were right-brained and 9 participants (18%) were whole-brained. The students had to study Top Notch series (book 2B) at an intermediate level. All the participants received exactly the same instruction, curriculum and course books. They also attended the same classes with the same teachers. At the end of the term a vocabulary achievement test(posttest) was given to the 50 participants of the study. Findings showed that the three groups involved, did not perform equally in their posttest performances, because of their different brain dominance. Mean score of the left-brained group was much higher than the other groups and the mean score of the right-brained group in turn was more than the mean score of the whole-brained group. The results also indicated that there was no statistically significant difference between male and female EFL learners' vocabulary achievement regarding their brain dominance.

Keywords: brain dominance, hemisphericity, vocabulary achievement.

Introduction:

Language learning is a complicated process drawing on a series of psychological, social, affective, linguistic, personal and interpersonal factors. These influencing factors are so determining in enhancing learning, interacting and communicating. Any language learner, who endeavors to learn a foreign language, wishes to be able to use the newly learned language effectively in communication. In other words, being able to express him/herself in a foreign language is considered to be a leading factor for any language learner in the process of language learning. Vocabulary is assumed as the constitutive blocks of discourse. In order to be able to speak and communicate in a foreign language, one has to have a comprehensive source of vocabulary knowledge; to the extent that mastering in other language skills greatly depends on vocabulary knowledge. As such, theory and practice of English language teaching has long considered this topic and the factors that can have an effect on it.

There are a number of factors that directly or indirectly have an effect on vocabulary achievement. Lots of studies have been carried out to find out the effective style of teaching and learning vocabulary. In language learning, vocabulary acquisition definitely plays an important role as Wilkins (1972) pointed out that "without grammar very little can be conveyed, without vocabulary nothing can be conveyed" (p.111). Learners need to have a comprehensive bank of lexical items in order to express themselves as part of and throughout the learning process. They also have to know how to master the essential lexical items. Nevertheless, vocabulary learning is often seen as the greatest source of problems experienced by foreign or second language learners. Learners feel that an inadequate vocabulary is the reason for many of their problems in both receptive and productive language use (Nation, 1990). Given such a critical role that vocabulary learning plays in foreign or second language acquisition, further investigation into learners' approaches and perception towards learning vocabulary is worthwhile.

In addition to teaching students with a wide range of abilities within already overcrowded classrooms, accommodating students with learning differences, and dealing with behavior problems, teachers now have to add teaching English to their schedule. As a result, language teachers are in need of research-based instructional techniques to use in English as a Foreign Language (EFL) instruction. With these challenges in mind, districts must decide on which is more beneficial to students' success: to hire more interpreters and buy more bilingual materials or to teach mainstream teachers explicit strategies for foreign or second language vocabulary acquisition.

The theory of brain dominance preference, that has gained great interest in the recent years, refers to the idea that people may rely on preferred mode of cognitive processing, which is linked to the activity on the part of the left or right cerebral hemisphere. Over the recent years, following a tremendous interest of studies of specialization of the cerebral hemispheres, there has been an increasing tendency toward the concept of brain dominance preference. Even though the term may have been applied differently by different writers, it is generally associated with the mode of cognitive processing which in turn implies the predominant activity either the left or the right cerebral hemisphere.

On the top of all, the characteristic of brain dominance has been attached with a number of aspects of personality, including reasoning, thought, and abnormal states. Most of the works in this area are related to educational and cognitive developmental aspects (Joseph, 1982; Kelin, Allen & Schwartz, 1998).

Brain dominance has therefore been considered to be relevant in different areas of education such as second or foreign language learning and acquisition. Undoubtedly, there are lateral differences between the cerebral hemispheres in the organization of human performance (Prince, 1978).

On the other hand, as the child's brain matures, various functions become lateralized to the left or right hemispheres. The left hemisphere is associated with logical, analytical thought, with mathematical and linear processing of information. The right hemisphere perceives and remembers visual, tactile, and auditory images, it is more efficient in processing holistic, integrative, and emotional information. Torrance and Reynolds (1980) and Krashen, Seliger, and Hartnett (1974) found support for the hypothesis that left – brain – dominant second language learners preferred a deductive style of teaching, while right – brain – dominant learners appeared to be more successful in an inductive classroom environment.

Research Background

Researchers attribute the success of the students in assimilating the new information to many factors. One of the factors that is worth mentioning is students' learning styles. Spada and Lightbown (2003) asserted that "learners have clear preferences for how they go about learning new material" (p.58). For this reason, teachers should discover the learning and cognitive preferences that students bring with them into the classroom and take those very learning preferences into account while teaching. Saleh (1997) asserted that prior to building the teaching and instructional practices, a full understanding of the students' learning styles should be obtained. Teachers can promote learning conditions by utilizing visual, auditory and kinesthetic activities (Lightbown & spade, 2003). In so doing, students' learning experiences will be promoted and they will learn elements of language through the channel that best fits their learning preferences.

Among the learning styles, brain hemisphericity, or to put it in more special terms, brain specialization has attracted the attention of some researchers. Tendero (2000) reported Sperry's study (1977) in which he propounded his split-brain model of intelligence as a result of his works on aphasic patients. In his seminal work he attributed some functions to different hemispheres of the brain. Brain has two hemispheres that are assigned different functions. Hergenhahn& olson (2005) stated that body functions have been assigned to both hemispheres "evenly but in a crossed fashion" (Kok, 2010, p. 145). Simply put, the right hemisphere is in control of the left side of the body and vice versa. Using Tendero's (2000) metaphorical statement about brain dominance, "In a sense, the body cannot serve two masters" (p. 8), We can state that often one side of the brain is dominant over the other.

In a similar vein, Brown (1994) maintained that "the left hemisphere is associated with logical, analytical thought, with mathematical and linear processing of information. The right hemisphere perceives and remembers visual, tactile and auditory images; It is more efficient in processing holistic, integrative and emotional information" (p.125). Krashen (1988) maintained that "left hemisphere is superior to the right in judging temporal order, deciding which of the two stimuli was presented first" (p.70). Brown (2007) reports Torrance's study (1980) in which he enumerated some of the features of the left and right brain dominant learners:

- Left-brain dominant learners: Intellectual; remember names; respond to verbal instruction and explanations; experiment systematically and with control; make objective judgments; planned and structured; prefer established certain information; analytic readers; reliance on language in thinking and remembering; prefer writing and talking; prefer multiple choice tests; control feelings; not good at interpreting body language; rarely use metaphors; favor logical problem solving
- Right-brain dominant learners: Intuitive; remember faces; respond to demonstrated ,illustrated or symbolic instructions; experiment randomly and with less restraint; make subjective

judgments; fluid and spontaneous; prefer elusive uncertain information; synthesizing readers; reliance on images in thinking and remembering; prefer drawing and manipulating objects; prefer open-ended questions; more free with feelings; good at interpreting body language; frequently use metaphors; favor intuitive problem solving

Tendero (2000) reports Munzert's study (1980) in which he points out that the functioning of the left and right hemispheres of the brain differ in the type of mental activities processed in them. According to Munzert (1980), on the one hand, the left hemisphere is the head- quarter for processing information that has to do with one's intellect such as memory, language, logic, computation, classification, writing and analysis. On the other, the right hemisphere is responsible for controlling functions involved in intuition, attitudes and emotions, music, rhythm, physical coordination and activity (Tendero, 2000).

Having investigated the functions that each hemisphere of the brain is responsible for, many researchers came to the factitious realization that brain hemisphericity can best be described as dichotomous. They held the belief that people are either left brain dominant or right brain dominant. However, recently some scholars have warned us of the inadequacies of this dichotomy. In a similar vein, brain hemisphericity should not be viewed as dichotomous, rather, it should "operate on a continuum" (Saleh & Irannejad, 1995, cited in Saleh, 2001, p. 194). To put it simply, things should not be divided into black and white. Brain hemisphericity is no exception. According to Saleh & Irannejad (1995) people should be spread across the brain hemisphericity continuum.

Oflaz (2011) reported Morris' (2005) study in which she maintained that left brain dominant learners are more comfortable in the classroom. The reason is that, in traditional schooling, much emphasis is put on analyzing and synthesizing language elements, something that left brain dominant students are good at. Revel (1992, cited in Oflaz, 2011) highlighted the fact that in many educational systems left brain dominant students are favored. On the contrary, in these contexts, right brain dominant students are, metaphorically speaking, smothered by teachers. "Creativity", something that right brain dominant learners are claimed to be good at, "is seriously impaired" (Oflaz, 2011, p.1509).

Saleh (2001) names some studies revealing that if students are taught through methods that match their hemispheric preferences, they will obtain higher scores, compared to when they receive random teaching instruction without any attention to their hemispheric preferences whatsoever (Brennan, 1984; Dunn, Sklar, Beaudry, Bruno, 1990; Jarsonbeck, 1984). There are studies (Kolb, 1979; MacCarthy, 1996; Saleh, 2001) that show that students mostly choose their field of study based on their hemispheric preferences.

Brown (2007) reports a study by Krashen, Seliger, Hartnett, (1974) in which they investigated the relationship between student's brain hemisphericity and teacher's style of teaching. They found out that left brain dominant learners preferred deductive teaching, whereas right brain dominant students were more interested in inductive classroom environment. Breien-Pierson (1988) investigated the relationship between brain hemisphericity and composition writing process. They found support for difference in the way right and left brain dominant learners approached writing. It was suggested that right-brained learners better function in free writing, whereas left brained ones enjoy research paper and book reports.

Last but not least, Tendero (2000) investigated the effect of brain hemisphericity on four macro language skills compared to their age and gender. According to her research the respondents' hemispheric dominance was negatively and insignificantly correlated with their listening and speaking skills; but was positively, although not significantly, correlated with reading and writing skills.

As the preceding section has revealed, a number of issues concerning the effects of brain hemisphericity on different aspects of second language education have been investigated, but, to the best of researchers' knowledge, nobody has worked on the relationship between brain hemisphericity and one's degree of vocabulary achievement.

Vocabulary learning is deemed as one of the most integral aspects of second language education. Language is composed of many components, one of which is vocabulary. The more vocabulary one knows, the easier he/she can express his/her thoughts. As soon as researchers came to realize the significant role of vocabulary in language learning, they investigated what factors contributed to effective and long-term retention of words. This study investigates if students' brain hemisphericity is one of those factors affecting vocabulary achivement. Researchers interested in this sphere, can examine the effects of one's brain hemisphericity on learning other language sub-skills.

Research methodology

The population, sample and sampling

The population of this study comprised of 50 EFL learners, male and female, selected from among 86 language learners in Navid Language Institute in Shiraz. All the students were native speakers of Persian, ranging from 17 to 30 years of age. The selected participants were assigned to three groups according to the results obtained from performing the Brain Dominance Inventory (Davis, Hafsah, and Ruru, 1994). The results of the Inventory showed that 18 participants (36%) were left-brained, 23 participants (46%) were right-brained and 9 participants (18%) were whole-brained. The students had to study *Top Notch* series (book 2B) at an intermediate level.

The data collection process was conducted with the permission granted from the institute.

Research tools

The 86 language learners took a proficiency test at the beginning of the term. The proficiency test was administered for homogenizing the participants. Then according to the results obtained from the proficiency test 50 language learners were selected as the subjects of the study. In addition, the learners' vocabulary scores were stored to be compared with the results obtained from the posttest. After this stage, The Brain Dominance Inventory (Davis, Hafsah, and Ruru, 1994) was administered to the 50 selected participants through group administration. The participants were given about 15 minutes to answer the questionnaires. They were provided with some information about the objectives of the study before the administration to avoid ambiguity of items and enhance the validity of their responses. The participants were then divided into three groups of right-brained, left-brained and whole-brained according to their performance of the inventory. However, they received exactly the same instruction, curriculum and course books. They also attended the same classes with the same teachers for about 20 sessions. At the end of the term a vocabulary achievement test was given to the 50 participants of the study. The scores were calculated, organized and categorized for data analysis phase.

The learners attended the classes twice a week for about three months that is to say for one term. The allocated time for each session was one hour and forty-five minutes. Throughout the semester, besides teaching other skills, vocabulary activities of the text books were focused.

Finally, the pre-test and post-test vocabulary scores of the three groups were compared to analyze the null hypotheses of the study.

In order to obtain measurable data with which the results of the present study could be statistically analyzed, the following instruments were utilized:
The first one was a proficiency test, the second one was The Brain Dominance Inventory (Davis, Hafsah, and Ruru, 1994) and the third one was a vocabulary achievement test.

1. The Proficiency Test

The proficiency test was in fact an achievement test which is usually administered by the institute at the end of each level. Based on the test results, the learners can move to the higher level. In the current study, this test was administered for homogenizing the participants at the beginning of the study. This test is divided into six sections: Listening, vocabulary, grammar, reading, writing and Speaking. All sections were administered in this study and each question carried one mark. The allocated time for this test was around two hours: 1 hour and 30 minutes for the written section, 20 minutes for listening, and 10 minutes for speaking. The number of vocabulary items was 30. The learners' vocabulary scores were also calculated and scored separately to be analyzed and then compared with the results obtained from the posttest.

2. Questionnaire

The Brain Dominance Inventory developed by Davis, Hafsah, and Ruru (1994) was used to determine whether a learner is a right-brained, left-brained or whole-brained(bilateral). The Brain Dominance Inventory included 39 multiple questions which inquire into different aspects of the participants' lives.

3. Vocabulary Achievement Test

A set of thirty multiple choice vocabulary questions developed by the researcher was used in the study as the posttest. The questions of the test were designed based on the vocabulary presented in the learners' book (Top Notch 2B). This test took about 30 minutes to be administered. The analytic rating scale of the vocabulary achievement test was used in order to rate the participants' pre-test and post-test performances. According to the goals of this study, special focus was on vocabulary achievement and the scores were used to compare the level of students' vocabulary improvement.
The reliability of the instruments of this study was estimated by the researcher using the Cronbach Alpha formula. The alpha levels indicated that the tests and the questionnaire were reliable to be used for the purpose of this study. The reliability indices are tabulated in Table 1 below:

Table 1. Reliability Statistics

	Cronbach's Alpha	N of Items
Proficiency Test(vocabulary part)	.799	30
The Brain Dominance Inventory	.85	39
Vocabulary Achievement Test	.76	30

The Analysis of Data

Data analysis procedures for this study were comprised of quantitative data analyses using *Statistical Package for the Social Sciences* (SPSS). The results answered research questions of this study through some descriptive statistics which represented Means and Standard Deviations of different variables under investigation as well as one-way ANOVA, and a series of T-test analyses which were used to determine whether differences between the sample means are statistically significant or not.

Research Findings

H01: EFL learners' brain dominance doesn't have any significant effect on their vocabulary achievement.

H02: There are not any statistically significant differences between Iranian male and female EFL learners on the achievement of vocabulary.

Results and Discussions

This part presents the results of the study and discusses the findings, based on statistical analyses on the collected data. The obtained results are tabulated and presented in related tables, proceeded by the discussions and interpretations of the findings.

As mentioned earlier, this study aimed at investigating the impact of EFL learners' brain dominance on their vocabulary achievement. It also aimed at providing evidence to show if there is any statistically significant difference between Iranian EFL learners' achievement of vocabulary due to their gender. To this end, the objectives of the study were described and presented by two research questions which were tested via two subsequent null hypotheses.

Descriptive Statistics

50 participants of this study were selected from among 86 EFL learners based on their proficiency scores. The proficiency test was in fact an achievement test which is usually administered by the institute at the end of each level. Based on the test results, the learners can move to the higher level. This test which includes all language skills was administered for homogenizing the participants at the beginning of the study. In addition, learners' vocabulary scores were separately calculated and stored to be analyzed and compared with the results obtained from the posttest. Then the 50 participants were divided into three groups according to the results obtained from performing the Brain Dominance Inventory (Davis, Hafsah, and Ruru, 1994). The results of the Inventory showed that 18 participants (36%) were left-brained, 23 participants (46%) were right-brained and 9 participants (18%) were whole-brained. In order to check their homogeneity, a one-way ANOVA was run on their proficiency scores. As it is clear from table 2, the mean score of three groups are approximately the same (66.80, 68.73 and 68.27). The descriptive statistics of the three groups are demonstrated in Table 2.

Table 2. Descriptive statistics for the proficiency test

1. Groups	2. Gender	3. N	4. Mean	5. Std. Deviation	6. Minimum	7. Maximum
8. Whole-brained group	9. Female	10. 6	11. 69.45	12. 3.689	13. 62	14. 73
	15. Male	16. 3	17. 63.12	18. 3.222	19. 64	20. 72
	21. Total	22. 9	23. 66.80	24. 3.256	25. 62	26. 73

27. Left-brained group	28. Female	29. 8	30. 66.09	31. 2.982	32. 65	33. 74
	34. Male	35. 10	36. 70.41	37. 3.890	38. 63	39. 75
	40. Total	41. 18	42. 68.73	43. 3.731	44. 63	45. 75
46. Right-brained group	47. Female	48. 14	49. 71.38	50. 4.305	51. 61	52. 75
	53. Male	54. 9	55. 64.50	56. 4.959	57. 66	58. 75
	59. Total	60. 23	61. 68.27	62. 4.891	63. 61	64. 75
65. Total	66. Female	67. 28	68. 68.97	69. 4.644	70. 62	71. 74
	72. Male	73. 22	74. 66.01	75. 3.512	76. 64	77. 75
	78. Total	79. 50	80. 67.76	81. 4.014	82. 62	83. 75

But in order to be sure whether there is any significant difference among the mean scores of the three groups or not, the data were analyzed through a one-way ANOVA; the results of which are shown in Table3.

Table 3. One-way ANOVA for proficiency test

84.		85. Sum of Squares	86. df	87. Mean Square	88. F	89. Sig.
90. Proficiency test	91. Between Groups	92. 30.533	93. 2	94. 15.267	95. .945	96. .397
	97. Within Groups	98. 678.267	99. 47	100. 16.149	101.	102.
	103. Total	104. 708.800	105. 49	106.	107.	108.

As the results of the ANOVA test in Table 3. shows, there has not been a significant difference among the three groups regarding their proficiency level ($F(2, 47) = 0.945$, $p = 0.397$).

Normality Assumption

The data obtained from the performance of the participants in the vocabulary tests were put into SPSS and One-Sample Kolmogorov-Smirnov Test (Table 4.) was run to test the normality of scores dispersion. Assuming zero shows the normality of the variables dispersion. If significance level is under 0.05, then the zero will be denied and the result of the dispersion normality is not acceptable.

Table 4. One-Sample Kolmogorov-Smirnov Test

109.	110. Group	111. N	112. Kolmogorov- 113. Smirnov Z	114. Asymp. Sig. 115. (2-tailed)
116. Pre-test	117. Whole-brained	118. 9	119. .635	120. .814
	121. Left-brained	122. 18	123. .510	124. .957
	125. Right-brained	126. 23	127. .506	128. .960
129. Post-test	130. Whole-brained	131. 9	132. .496	133. .967
	134. Left-brained	135. 18	136. 1.069	137. .203
	138. Right-brained	139. 23	140. .703	141. .706

Based on the results of One-Sample Kolmogorov-Smirnov Test, shown in Table 4. the normality of the scores in pre-test and post-test was assured and the following tests were computed for answering the research questions.

Inferential Statistics Used to Answer Research Question One

The first part of data analysis referred to the first research question of the study which aimed at investigating the effect of EFL learners' brain dominance on their vocabulary achievement.

To answer the first research question a paired sample T-test was conducted to see if there is any significant difference in the vocabulary scores of the pretest and posttest for all the three groups.

Table 5. Paired Sample T-Test for the whole-brained group

142. Group	143.	144.	145. Mean	146. N	147. Std.Deviation	148. T	149. Df	150. Sig.(2-tailed)
151. Whole-brained	152. Pair 1	153. Pre-test	154. .599	155. 9	156. 0.136	157. -5.323	158. 8	159. .001
		160. Post-test	161. .623	162. 9	163. 0.082			

As table5. shows the vocabulary mean score for the whole-brained group in the posttest is bigger than the pretest and the significance level is smaller than 0.05, ($t(8) = -5.323$, $p=0.001$), so we can conclude that the vocabulary measurement in the whole-brained group has shown a significant increase.

The paired sample T-test was also conducted for the left-brained group to see if there is any significant difference in the vocabulary scores of the pretest and posttest for the left-brained group, the results of which are shown in Table 6.

Table 6. Paired Sample T-Test for the left-brained group

164. Group	165.	166.	167. Mean	168. N	169. Std. 170. Deviation	171. T	172. Df	173. Sig.(2- 174. tailed)
175. Left-brained	176. Pair 1	177. Pre-test	178. .587	179. 18	180. 0.128	181. -8.515	182. 17	183. .000
		184. Post-test	185. .876	186. 18	187. 0.094			

As it is clear from the Table 6, the mean of the vocabulary scores in the posttest (.876) is bigger than pretest (.587) and significance level is smaller than 0.05 (t (17) = -8.515, p= 0.000), so we can conclude that the vocabulary measurement in the left-brained group also has shown a significant increase.
The same test was performed for the right-brained group as well. The results of the paired sample T-test for the right-brained group are shown in Table 7.

Table 7. Paired Sample T-Test for the right-brained group

188. Group	189.	190.	191. Mean	192. N	193. Std. 194. Deviation	195. T	196. Df	197. Sig.(2- 198. tailed)
199. Right-brained	200. Pair 1	201. Pre-test	202. .615	203. 23	204. .112	205. -3.757	206. 22	207. .002
		208. Post-test	209. .736	210. 23	211. .066			

Table 7. shows that the mean of the vocabulary scores in the posttest (.736) is bigger than pretest (.615) and significance level is smaller than 0.05 (t (22) = -3.757, p= 0.002), so we can conclude that the vocabulary measurement in the right-brained group has also shown a significant increase.
The results of Tables 5, 6 and 7 indicates that all the three groups had improvement in vocabulary achievement. However, based on the first research question, the researcher wanted to find out if there is any significant difference among the three groups regarding their vocabulary scores in the post-test. To answer this question, the researcher conducted a one-way ANOVA analysis. Assuming zero shows that there is no difference between two variables. If the significance level is under 0.05 then the zero assuming

will be denied. Table 8. shows the descriptive statistics in the three groups. The variances equality in the three groups is needed for testing the means. So this test is done by Levene's statistics.

Table 8. Descriptive & Test of Homogeneity of Variances

212.	213. Group	214. N	215. Mean	216. Std. Deviation	217. Levene's Statistic	218. df1	219. df2	220. Sig.
221. Post-test	222. Left-brained group	223. 18	224. .876	225. .094	226. 2.431	227. 2	228. 47	229. .100
	230. Right-brained group	231. 23	232. .736	233. .066	234.	235.	236.	237.
	238. Whole-brained group	239. 9	240. .623	241. .110	242.	243.	244.	245.
	246. Total	247. 50	248. .745	249. .138	250.	251.	252.	253.

As it is indicated in table 8, the mean score of the left-brained group (0.876) is much higher than the other groups and the mean score of the right-brained group (0.736) in turn is more than the mean score of the whole-brained group which is 0.623.

In order to see whether this difference among the groups is statistically meaningful or not, the researcher conducted a one-way ANOVA test, the results of which are shown in table 9.

Table 9. ANOVA test for the comparison of groups

254.	255.	256. Sum of Squares	257. df	258. Mean Square	259. F	260. Sig.
261. Post-test	262. Between Groups	263. .481	264. 2	265. .241	266. 28.360	267. .000
	268. Within Groups	269. .356	270. 47	271. .008	272.	273.
	274. Total	275. .837	276. 49	277.	278.	279.

As the results of ANOVA test (F (2,47) =28.36, p= 0.000) in table 9, show, the difference among the participating groups' vocabulary measurement was significant. The values observed for the F and *p* value indicated that the three groups involved, did not perform equally in their performances, because of their different brain dominance.

To statistically identify the location of this difference, a post-hoc Tukey was also run. The results of Tukey HSD analysis are represented in Table 10.

Table 10. Tukey HSD

280. (I) Group	281. (J) Group	282. Mean Difference (I-J)	283. Std. Error	284. Sig.
285. Left-brained	286. Right-brained	287. .139600*	288. .033628	289. .000
290.	291. Whole-brained	292. .252800*	293. .033628	294. .000
295. Right-brained	296. Whole-brained	297. .113200*	298. .033628	299. .005

As the results of Table 10, indicates the vocabulary mean score of posttest in left-brained group is significantly bigger than right-brained and whole-brained groups. Likewise, the vocabulary means score of the posttest in right-brained group is significantly bigger than that of the whole-brained group.

Inferential Statistics Used to Answer Research Question Two

The second research question of the study aimed to investigate if there is any statistically significant difference between Iranian male and female EFL learners' achievement of vocabulary due to their brain dominance.

Independent sample t-test was applied to answer this question. Table 4.10 shows the results of independent sample t-test for the effect of gender on EFL learners' achievement of vocabulary due to their brain dominance.

Table 11. Independent sample t-test for the effect of gender

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	
Willingness to	Equal variances assumed	2.668	.105	-2.547	48	.120	

communicate	Equal variances not assumed			-2.547	46.894	. 120	

As Table 11,indicates, for F=2.668, Sig. =.120>0.05. Sig. value is above .05, so it can be said that there is not a statistically significant difference between male and female EFL learners' vocabulary achievement according to their brain dominance.

Conclusion:

The ultimate goal of the present study was to investigate the effect of EFL learners' brain dominance on their vocabulary achievement. Besides, the study aimed to investigate if male and female EFL learners hold significantly different performances in vocabulary achievement based on their brain dominance. In what follows, the research questions are answered in light of the findings of the study:

To summarize the major findings of this study in terms of research hypotheses set at the outset, the null-hypothesis predicting that EFL learners' brain dominance doesn't have any significant effect on their vocabulary achievement was rejected. Therefore, the effect of brain dominance on vocabulary achievement was confirmed in this study. Additionally, the left-brained group indicated more improvement in their vocabulary achievement than the right-brained and whole-brained groups. However, right-brained group had better results than the whole-brained group. In fact, the results revealed that the systematic variation between groups' performance on post-test was due to their brain dominance. Accordingly, it can be speculated that brain hemisphericity affected the vocabulary achievement of Iranian EFL learners.

The results of data analyses demonstrated that there is a statistically significant difference in the performance of left-brained, right-brained and whole-brained groups. Therefore, it can be concluded that there is a direct relationship between EFL learners' brain dominance and their vocabulary improvement in EFL classes. As such, the first research hypothesis of the study which predicted no relationship between learners' brain dominance and their vocabulary achievement in EFL classes is rejected.

The results obtained highlight the potential benefits of being aware of one's brain hemisphericity which can positively affect vocabulary improvement among EFL learners. The results showed that there was a significant difference among the means of the participants of the three groups regarding their vocabulary skill during the test process. The left-brained group had a significantly better performance in comparison with the other groups.

All the results of this study indicate that the brain dominance affects the achievement of the students in English classrooms. Taking all these into consideration teachers can find the efficient strategies for their own classrooms. Being aware of own brain dominance will also help the teacher not to teach only through his / her own dominance. By finding out the brain dominance of the students and giving activities according to them, the teacher might also improve the efficiency of his or her own teaching, increase the success rate and also advise the students on learning strategies and recalling. All of the information can serve teachers to make sure that they appeal to all learners with different brain dominances and provide their learners experiences with all three modalities. They should find a way to combine all three to make their learners enhance, to create the right atmosphere to make learning easier and more enjoyable and to help students to reinforce their knowledge with meaningful activities.

These findings are consistent with the findings obtained by Brown (2007) and Palincsar&Herrenkol(2002), who noted that left brained learners can have the ability of higher order thinking and problem solving in comparison with right-brained learners who are good at responding to demonstrative instructions and visuals (Bavand Savadkouhi, et al. 2013).

Based on the findings of the analysis, the present research study revealed that the mechanisms that control the functions of the brain are too intricate to be captured within a research study. However, the experimental design of a research study needs a lot of time, effort and preparations.

It could be argued that although the two hemispheres may appear to be similar and both sides of the brain are able to analyze process and store information from thoughts and ideas and also make decisions, one side of it is usually more dominant than the other side (Day, 2009), and in normal state each has specific functions. As mentioned earlier the left hemisphere is lateralized for mathematical and language abilities, analytical thought, logical thinking, sequencing, categorizing, planning, speech, spelling, as well as word and number recognition while the right hemisphere of the brain is dominant for emotions, creativity, music and rhythm, intuition, sensitivity, daydreaming, spontaneity, humor, emotions, exploration, experimentation, inventiveness, musical expression, hands- on learning and creativity (Soleimani & Sharifi-Matin, 2012).

The results also indicated that there was not a statistically significant difference between male and female EFL learners' vocabulary achievement regarding their brain dominance. This result is not significant enough to reject the second null hypothesis of the study which predicts no relationship between the role of gender in vocabulary achievement of Iranian EFL learners. These results imply that gender is not a factor which affects EFL learners' vocabulary achievement in case of their brain dominance. Gender was found not to have significant effect on their performance and that the difference between male and female learners was not meaningful. Therefore, the factor of gender can be ignored. The findings of this study is congruent with findings of Ryan (1994) who suggested that there was little differential performance by gender. However, the results of the study seem not to be in consistence with the studies of Goh & Foong (1997), Nam & Leavell (2006), Taguchi (2002) and Catalan (2003), all of whom favored females as better users of language learning strategies. However, in recent years, a considerable amount of academic literature has focused on the concept of gender in learning strategies (e.g. Von Flotow 2001, Simon 1996, and chamberlain 1988).

Practical suggestions:

This study tried to investigate how brain hemisphericity may affect vocabulary improvement among EFL learners. The findings of the study have indicated that:

1. According to the theory of hemisphericity, language learners are different in their learning language skills. Generally, it can be said that an understanding of hemisphericity theory broadens teachers' awareness of their students' knowledge and skills of processing and enables them to look at each student from the perspective of his strengths and potential (Tendero, 2000).

2. By understanding the hemispheric dominance of their students, teachers can have more variety in the way of their teaching and give assignments to students in order to increase their effectiveness in meeting each student's needs.

3. In addition, teachers can use hemisphericity theory acts as a guide for developing classroom activities that address multiple ways of cognitive information processing (Ming, 2005).

4. It is also implied that, it is not the teachers' responsibility to teach all vocabulary to the learners. Learners should depend on themselves by adopting strategies that suit their abilities in learning vocabulary. Vocabulary learning is not always easy, but with practice and time, learners can find that they are making progress.

5. Learners should study items that appear in many contexts. Learning in rich contexts is valuable for vocabulary learning. Vocabulary words should be those that the learner will find useful in many contexts. When vocabulary items are derived from content learning materials, the learner will be better equipped to deal with specific reading matter in content areas.

6. Learners will feel that vocabulary learning is effective when it entails active engagement in learning tasks. As a conclusion, it can be said that investigating hemispheric dominance and learning styles from the aspects of curriculum, teaching process and teachers will contribute significantly to the Iranian Education.

7. The result of this study may benefit most the language teachers, the English Department, the school administrators, the policy makers, and the producers/developers of language instructional materials.

8. For the English Teacher, the result of the study may direct them to look deeper into the parts of their English syllabi that need some improvement, enrichment or revision. It may also encourage them to improve their teaching styles to suit to the students' learning styles and diversify activities as well as methods of teaching to optimize learning success of students.

9. For the English Department, the result of the study may be used as basis in the department's preparation and production of suitably diversified language teaching and testing materials for classroom utilization by the English major as well as by the non-English major students.

10. For the school administrators, the result of the study may provide them insights as to the teaching needs of their language faculty as basis in designing and conducting appropriate in – service trainings that may help revitalize the teaching of English in the tertiary level in terms of content, materials and methodology.

11. As far as some recommendations for action are concerned, educational systems constantly look for teaching methods that meet the diverse learning styles and needs of today's students. Administrators and teachers alike go through various trainings each year to investigate and implement different strategies and styles to ensure that students reach optimal academic achievement.

12. Many systems adopt programs and require teachers to follow these specific programs in their daily instruction. The results of this study revealed that the use of vocabulary strategy training had a positive effect on vocabulary achievement. Further, while all students showed gains in test scores from pretest to posttest, the left-dominant learner group achieved significantly better tests scores than did the right-dominant group without any kind of instruction. This study was able to report findings similar to those of other studies in which the use of vocabulary learning strategies promoted academic achievement (Adams, 2000; Stevens, 2003).

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