The Forgotten Variable in Educational Contexts and Sustainable Development: Learners' Life Style, Brain Functioning, and Nutritional Status in Language Learning

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Abstract

A danger to any field of science is to be one-dimensional, and the realm of pedagogy is not an exception. That is why such branches of study as educational nutrition have emerged. This study has made an attempt to determine if there is an association between one of the main parameters of lifestyle, which is the brain nutritional status of the university students and their achievement in learning, in general, and acquiring different language courses, in particular. The study was a correlational/cross-sectional research project carried out on 232 (31 males and 201 females) English-major students in some of the Language Departments and Institutes in Tehran. The data regarding the students' nutritional status and their language achievements was collected using a validated standardized/localized Food Frequency Questionnaire (FFQ) (Mirmiran et al., 2009) and a Self-Evaluation scale. Unlike the reading, writing, and grammar courses, the listening/speaking data showed a high correlation (2-tailed, $P<.005$) with all the nutrients (with the exception of fiber). The significant correlation with the laboratory course (listening/speaking) could be due to the fact that the syllabus and rating procedure for this course were roughly the same among the university instructors unlike other courses. At the next stage of the study, the students were divided into two groups: with nutrient deficiency and without deficiency, to determine the exact percentages of their malnourishment. The final phase of the study

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focused on triangulating the data by checking their immune system status via the self-evaluation questionnaire, which indirectly validated the data obtained at the early stages of the data collection. The final phase of the study focused on triangulating the data by checking their immune system status via the self-evaluation questionnaire, which was an indirect way of validating the data obtained at the early stages of the data collection. The findings indicated that there was an immunodeficiency for around 70% of the students, which supported the first-stage findings. This bears some (thought-provoking) implications and implies that the stakeholders in curriculum development are required to internalize and plan some 'educational nutrition' programs in order to achieve higher levels of success and move towards sustainable development.
Keywords: nutritional status, language learning, Food Frequency Questionnaire (FFQ)

1. Introduction

For years, policymakers, administrators, and teachers/instructors have tried to improve the process of learning, in general, and language acquisition, in particular, in the educational contexts at the macro and micro levels. They have devised new methods of instructions, improved classroom situations, developed novel teaching tools and textbooks and tried to modify the whole pedagogy system to facilitate the learning/teaching procedure. However, have these been sufficient for such a complex process of learning and particularly foreign language learning? Why are some teachers still experiencing that their students have some learning and focus problems in a foreign language? Has there been enough attention to the learner and his brain condition and necessities including the nutrients in the learner's blood to cope with such a complicated phenomenon? In other words, is the learner's brain provided with the required macro/micronutrients (i.e., the necessary vitamins and minerals as micronutrients and carbohydrate, fat, and protein as macronutrients) to function properly? Can the learner's focus and learning problems in acquiring language be traced in his malnutrition? There has been an attempt in this research study to address these questions meted out in order to determine if an association is observed between the nutritional status of the language major university students and English learners from one of the institutes and their performance in learning a foreign language that is their achievement in such language courses as reading, writing,

listening/speaking, and grammar courses and their total language (i.e., English) ability.

2. Literature Review

Language learning involves a highly complicated brain functioning and in learning a language human brain "works heavy statistic" (Newport & Aslin, 2004). Grasping certain relationships between language elements is so complicated, and according to Newport and Aslin (2004), we are incapable of consciously comprehending them. This complex process of language learning requires a well-developed brain mechanism. Nutritional factors may have a significant impact on the brain development and functioning that is malnutrition can cause the brain's malfunctioning (DeLong, 1993).

In past decades, there has been more concern on the significance of the learners' nutritional status and the amount of vitamins and minerals intake and the role it plays in the learning process (Florence, Asbridge, & Veugelers, 2008; Fu, Cao, & Peng, 2007; Kleinman, Hall, Green, Korzec-Ramirez, Patton, Pagan, & Murphy, 2002; Moghaddam Banaem, 1377, 1998; Pertz & Putman, 1982; Rampersaud, Pereira, Girard, Adams, & Metzl, 2005; Zande Vakili, 1377, 1998). Most of the studies are devoted to the examination of the overall academic achievements of the school children and adolescents. In a study carried out in 2008, it has been stated that “undernourished children have decreased attendance, attention, and academic performance as well as experience more health problems compared to well-nourished children” (Florence, Asbridge, & Veugelers, 2008). In some other studies there has been an increasing concern about the impact of breakfast on the students' brain functioning, behaviour, and achievements in different school subjects (Pollitt & Matthews, 1998; Tara, 2005). In addition, malnutrition and low levels of nutritional intake can have a negative impact on the students' concentration (e.g., through zinc deficiency), tiredness (e.g., low level of vitamin C, copper, & iron), anxiety (e.g., low level of magnesium or iron), energy deficiency (e.g., low level of copper & iron), immune system (e.g., zinc, copper, and vitamin A & C deficiency), memory and learning power (e.g., low level of vitamin A, K, & D), and brain functioning (iodine, folic acid, omega-3, vitamins B & E, & calcium deficiency), which in turn have an effect on the learning procedure and are an indirect implication of nutrients deficiency. The focus of the present research was on examining the impact of nutrition on the

brain functioning and learning a foreign language and the above mentioned factors and the students' status of their immune system as an indirect indication of their nutritional pattern. In other words, in the present study the participants' nutritional status was examined both directly, through analyzing the Food Frequency Questionnaire (FFQ) and determining the amount of the nutrients intake of each subject, and indirectly, through examining the status of each participant with regard to his/her immune system.

In a seminal study entitled "vitamins fight learning disabilities", it was found that taking the supplements of such vitamins as riboflavin (B 2), niacin (B 3), vitamin E, and thiamin (B 1) can improve the brain cognitive functioning of children with learning disabilities (Harrell, 1981). The significant role of vitamins and minerals in learning and memory power has been highlighted in a number of other research studies in which it was supported that a correlation existed between the learning, brain functioning, and memory power and such nutrients as iron (Bryan, Osendarp, Hughes, Calvaresi, Baghurst, Jan-Willem, 2004; Gordon, 2003; Sachdev & Nestel, 2005), zinc (Bryan et al., 2004; Black, 2003), vitamins B, A, C, D, K, magnesium, copper, manganese, iodine, folic acid, and omega 3 (Bryan et al., 2004). In the study of "the remarkable role of nutrition in learning and behavior", it was concluded that micronutrients such as fatty acids, minerals and vitamins have potent effect on the function of the brain and the prevention of such learning disorders as attention deficit hyperactivity (Dani, Burrill, & Demmig-Adams, 2005).

A danger to any field of study is to become one-dimensional. The field of education and language learning is not an exception, that is it needs to take advantage of the research studies carried out in other branches of science, and for long it has actually benefited from their findings, which has been the source of different interdisciplinary fields. Following the same procedure, the present study made an attempt to highlight the new trend of nutrition-learning research and more specifically to bridge the gap between language learning and nutritional science as one of the most beneficial branches to any majors of study involving learning process. The aim of this research study, as one of the first research projects examining the impact of the forgotten variable of nutritional status on language learning ability of EFL (English as a Foreign Language) major students in the local context of Iran, was to put stress upon the role such nutritional elements as vitamins and minerals can play in the highly complex process

of language learning and the proper functioning and performance of the brain.

3. Method

3.1. Participants

Since most of the language learning courses (i.e., reading, writing, grammar, and listening/speaking) are usually passed during the first terms of the students' BA studies, the participants were all selected via purposive/cluster sampling from the second or third-year students. Out of the 350 FFQ and Self-Evaluation questionnaires distributed, only 201 female and 31 male students (total number: 232) completed all the required items in the two questionnaires; therefore, the rest were excluded from the study. The participants were from different tertiary level contexts: University of Tehran (28), Al-Zahra (33), Allame Tabataba'i (22), Shahid Beheshti (17), and Kharazmi (71) universities, and also 28 participants were from the non-profit university of ministry of science (i.e., Ershad). In addition, 33 participants were from Iran Language Institute (Kanoon Zaban). An informed written consent was obtained from each subject before administering the data collection procedure. The reasons for the outnumbering of the females over the males were that: first, two of the universities in the survey, namely, Al-Zahra and Ershad were basically women's universities and there were no male students in these two colleges; and the second reason was that female subjects were more cooperative in answering the questionnaire items. The participants' age ranged from 18 to 25 and they were informed that their privacy would be protected and the researcher would take care of the anonymity and confidentiality of the research study and the pertaining findings.

3.2. Instrument

In order to obtain the overall nutritional pattern or the dietary behaviour of the learners, the nutrition tool of Food Frequency Questionnaire (FFQ) was used. This questionnaire had been validated, localized and standardized by the Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences (Mirmiran, Hosseini, Mehrabi, Hedayati, & Azizi, 2009). The procedure for data collection regarding the FFQ was that the trained dieticians asked the participants to designate their consumption frequency for each food item during the whole year on a daily, weekly, or monthly basis. Portion sizes of consumed foods that were reported in household measure were then converted to grams. Because the Iranian

Food Composition Table (FCT) (Azar & Sarkisian, 1980) was incomplete, and with limited data on nutrients content of raw foods and beverages; the foods and beverages were analyzed for their energy and nutrient content using the United States Department of Agriculture (USDA) FCT (USDA, 2005).

To obtain other required information concerning the students' scores in their language learning courses (i.e., reading, writing, grammar, speaking-listening) and the total language ability (the mean score of all the mentioned courses) and the status of their immune system which indirectly evaluated the students' nutritional status, the researcher used a self-evaluation questionnaire containing 19 items (with some sub-items) (developed by the researcher). The objective of asking the subjects some questions regarding their immune system (e.g., the exact number of times they usually catch a cold in a year, which is a determinant of the status of their immune or defense system) was to indirectly determine if the language learners received the standard levels of nutrients. As mentioned before, these nutrients are necessary for brain's functioning and focus in any learning process, in general, and the complicated phenomenon of language learning, in particular. The reason for adopting this second indirect way of examining the subjects' nutritional status was that answering the questions of the FFQ required the participants to remember the exact amount of their nutrients intakes on a yearly basis (in addition to their daily and weekly consumptions) and this could make the whole procedure susceptible to the subjects' memory, which could affect the result of the analyses of their nutrients intakes. That is, adopting an indirect way of rechecking the participants' responses through examining the subjects' immune system could place the researcher on a safer side in order to analyze the results and increase the reliability of the findings.

4. Results

The descriptive data regarding the students' nutrients intakes and their scores in different language courses (i.e., the mean scores of the reading comprehension, writing, grammar, listening, and speaking), and the total language ability which was the mean of all the mentioned language courses have been presented in Table (1).

Table (1)

Correlation Analyses Between Students' Language Learning Abilities and Amount of their Nutrient Intake

		Correlation Coefficients of Mean Scores of Language Learning Courses				
		Reading	Grammar	Laboratory (listening & speaking)	Writing	Total L. L. Ability
Kilocalorie		-0.10	-0.04	*0.17	-0.01	-0.07
Vitamin A	gμ	-0.03	0.02	**0.27	0.01	0.007
Thiamin (B 1)	Mg	-0.08	-0.05	**0.25	-0.02	-0.08
Riboflavin (B 2)	Mg	-0.05	-0.004	*0.14	0.01	-0.01
Niacin (B 3)	Mg	-0.07	-0.01	**0.20	0.000	-0.05
Vitamin B 6	Mg	-0.07	-0.01	*0.14	0.006	-0.03
Vitamin C	Mg	-0.04	0.003	*0.17	-0.003	-0.03
Vitamin D	gμ	0.09	0.09	*0.14	0.09	0.10
Vitamin E	Mg	-0.11	-0.05	*0.16	-0.05	-0.11
Vitamin K	Mg	0.04	0.05	*0.15	-0.05	0.05
Protein	G	-0.06	-0.02	**0.25	0.004	-0.04
Iron	Mg	0.01	0.03	*0.15	0.03	0.03
Calcium	Mg	0.002	0.004	**0.23	0.02	0.01
Folic Acid	gμ	-0.06	-0.03	**0.25	-0.003	-0.05
Phosphor	Mg	-0.04	-0.02	**0.27	-0.001	-0.03
Magnesium	Mg	-0.04	-0.01	**0.21	0.007	-0.02
Zinc	Mg	-0.05	-0.03	**0.21	0.002	-0.03
Copper	Mg	-0.04	-0.02	**0.21	-0.01	-0.04
Manganese	Mg	0.000	-0.01	*0.18	0.02	0.005
Fiber	G	-0.06	-0.01	0.13	0.006	-0.03
Omega 3	G	-0.08	-0.04	*0.17	-0.02	-0.06

***. Correlation is significant at the 0.05 level (2-tailed) i.e. P<.005**

****. Correlation is significant at the 0.01 level (2-tailed) i.e. P<.001**

In order to determine the exact frequency and percentage of the number of students who had malnutrition with regard to each particular nutrient, they were categorized into two groups, namely, students with nutrients deficiency and those without deficiency to determine the exact percentages of their malnourishments. Table (2) demonstrates the percentages of the vitamin and mineral intakes of the participants with or without deficiency.

Table (2)

Percentages of Vitamin and Mineral Intakes of Students with or Without Deficiency

Nutrients	Percentages of Vitamin & Mineral Intakes of Students with or without Deficiency	
	With Deficiency	Without Deficiency
Vitamin A	46.6	53.4
Thiamin (B 1)	1.7	98.3
Riboflavin (B 2)	3.0	97.0
Niacin (B 3)	3.9	96.1
Vitamin B 6	0.9	99.1
Vitamin B 12	10.3	89.7
Vitamin C	7.4	92.6
Vitamin D	84.5	15.5
Vitamin E	52.6	47.4
Vitamin K	7.9	92.1
Protein	3.0	97
Folic Acid	5.6	94.4
Iron	8.3	91.7
Calcium	1.3	98.7
Phosphor	0.4	99.6
Magnesium	14.0	86.0
Zinc	8.7	91.3
Copper	100.0	0
Manganese	0.4	99.6
Fiber	8.7	91.3
Omega 3	33.2	66.8

Mahan Lk , Escott-stump S. Krause's Food & nutrition Therapy. 12th ed., United States: Saunders (2008)

Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D (1997),

Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12 (1998),

Dietary reference intakes for vitamin C and vitamin E (2000),

Dietary reference intakes for vitamin A, vitamin K, copper, manganese and zinc (2001).

As mentioned earlier in another phase of the study, the researcher focused on triangulating the data by checking the participants' immune system status via the self-evaluation questionnaire, which was an indirect way of validating the data obtained at the early stages of the data collection. Table (3) below presents the result of the self-evaluation questionnaire filled by the students showing the frequency and percentages of their 'yes' or 'no' answers to the questions regarding their immune (defense) system and the number of times they caught cold in a year, which is a well-known indicator of their immune mechanism.

Table (3)

Number of Times of Catching Cold in a Year Representing the Status of the Students' Defense/Immune System

Variable		*Frequency*	*Percent*
Catching Cold	1. Once a year	69	30
	2. Twice a year	91	39.6
	3. Three times a year	26	11.3
	4. Four times and more	44	19.1
	Missing	2	-
	Total	232	-

5. Discussion, Conclusion, and Implications

As clear from Table (1) presented earlier, a high significant correlation exists between all the nutrients (with the exception of fiber) listed in the Table and the listening and speaking achievements of the students majoring in English in different language faculties and institutes. The significant correlation with the laboratory course (listening/speaking) could be due to the fact that the syllabus and rating procedure for this course were roughly the same among the university instructors unlike other courses. The correlation between the listening/speaking course scores and some of these nutrients such as B2, B6, C, D, E, K, iron, manganese, and omega 3 was significant at the .005 level and for such nutrients as A, B1, B3, protein, calcium, folic acid, phosphor, magnesium, zinc, and copper the level of significant correlation was .001. The findings are in line with those of Florence, Asbridge and Veugelers (2008) since in their study they

came up with the idea that malnourished children's level of academic performance decreased due to their nutritional status. On the contrary, in the present study no significant correlation or affinity was observed between the students' performance in other language learning courses and their nutritional status. That is, no significant statistical relationship existed between different nutrients and such language courses as reading, grammar, writing, and total language learning ability. This could be due to the fact that in these courses the instructors in different universities used different syllabi and testing systems to evaluate the students' language learning abilities while the content and the rating procedure for the listening and speaking course unit were roughly the same among the instructors teaching them. In other words, the objectivity parameter in the listening/speaking course due to the similarity of the teaching material and the testing procedure among different universities in comparison to the great amount of subjectivity of the reading, grammar, writing courses and their combination as the total language ability caused great differences in the participants' scores in these courses and as a result in the correlation coefficients. Another reason might be the complicated and demanding nature of the listening/speaking courses and the fact that more Cognitive Load might be imposed on the students' concentration and memory power for which more nutrients and minerals/vitamins may have been required for the brain to function properly.

As demonstrated in Table (2), although majority of the low percentages appear in the 'With Deficiency' (first) column, in the same column there are roughly very high percentages (appeared in boldface) for some nutrients such as vitamins A, D, E, Copper and Omega 3. The bold figures in the first column indicated that there was a greater deal of malnutrition with regard to these prominent nutrients. These percentages were the result of the statistical analyses of the FFQ or the Food Frequency Questionnaire which, as mentioned earlier, was a direct way of analyzing the degree of the students' malnutrition. These findings are compatible with the findings of Bryan, et al. (2004) who maintained that such nutrients as copper, omega 3, vitamins A and D are highly correlated with learning, brain functioning and memory potentials. In addition to this approach, the amount of the vitamin-mineral deficiency of the participants in this study was indirectly assessed through examining the number of times of the students' catching cold in a year (presented in Table 3) as an indicator of their body immune/defense system. This issue, as mentioned above, was

an indirect way of scrutinizing the level of nutrients in the participants under study. As clear from Table (3), 70% of the participants in the study (Groups 2, 3, & 4) had different degrees of problem with their body defense system since they caught cold twice or more in a year indicating that they lacked enough levels of the required vitamins and mineral to protect them, which was again another indicator of their malnourishment. That is, the immune system problem, as mentioned earlier, could be an indication that the subjects experiencing it, may have suffered from such vitamin/mineral deficiencies as zinc, copper, and vitamins A and C. These results support Chandra's (1997) findings and the claim that "nutrition is a critical determinant of immune responses and malnutrition is the most common cause of immunodeficiency worldwide". Selahvarzian, Shabani, Davoodi, and Hasannezhad Halimeh Jani (1400) maintained that the depletion of nutrients in the agricultural soil has caused a decrease in the level of the people's immune system.

As the findings of this research study presented in Tables (1-3) demonstrate, a high significant correlation existed between the EFL major university students'/English-learners' nutritional status and their achievement in their listening and speaking ability as the two prominent language skills. This indicated that the lack of enough levels of the minerals and vitamins could affect their language learning performance as a highly complex learning process which necessitates a well-prepared brain mechanism. In other words, if the students' brain was not well nourished with regard to the required nutrients, the brain could not function properly and as a result language acquisition phenomenon and listening/speaking performance did not take place effectively. The findings are in line with some more recent research studies carried out by Zerga, Tadesse, and Ayele (2022) since in their study, too, malnutrition affected the academic performance of the elementary school children. The students' malnutrition status could also affect some of their abilities such as their concentration and memory power, which were the crucial variables in improving their learning potentials. The findings are in accordance with Harrell's (1981) claim that the amount of enough nutrients intake in children with different learning disabilities can improve their cognitive functioning to a great extent. Their deficiency in different vitamins and minerals could also influence their normal life procedure through the

weakened immune system (as demonstrated in Table 3), which could also have an indirect impact on their educational and language learning progress.

The findings of the present research study can help language learners, teachers, and language curriculum developers to pay more serious attention to the nutritional factors and to the crucial role various vitamins and minerals can play in the process of learning, in overall, and English language acquisition, in particular. This study shows that a language learning curriculum requires planning some 'nutrition education' programs for the students and their families in order to achieve higher levels of success. This is what has been emphasized in the more recent trends in educational system, that is Brain Based Learning (BBL) (Caine and Caine, 1991) and its new version Brain Based Language Learning (BBLL). Based on this dateless theory (BBL), the brain physiology and its major rules are of great significance and absolutely vital in its functioning during the learning process (Caine, R. N. & Caine, G., 1991, 1994, 1995, 1999; Caine, R. N., Caine, G., & Crowell, 1999; Caine, R. N., 2005; Jensen, 1995, 1998, 2000a, 2000b, 2005, 2008). That is why Jensen (2000) explained BBL as learning with the brain in mind. In addition, the present research has some important implications for the catering services within language faculties and institutes to boost the quality of the served foods since the nutritional ingredients of what students take has a direct impact on their brain functioning and as a result on their learning and focus power especially in such complicated language skills as listening and speaking. The researcher hopes to increase the awareness of the potential impact of the nutritional parameters in facilitating the learning power of the language learners and to help students develop positive attitudes towards appropriate/good nutritional practices, establish lifelong healthful eating patterns, and take action for efficient healthcare by fixing their lifestyles.

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