Foreign Language Learning Strategies in the Context of STEM Education[1]

Estrategias de Aprendizaje de Lenguas Extranjeras en el Contexto de la Educación STEM

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Abstract

This study aims at providing an insightful evaluation of the EFL strategies used by first-year STEM (science, technology, engineering, and mathematics) students, and their perceptions of their own use of strategies. The 147 participants were undergraduate level, first-year engineering students at a state university in Turkey. Their ages ranged from 18 to 24. They took the Young Learners' Language Strategy Use Survey (LSS). In addition, a sub-sample of students was interviewed about the strategies they used in learning language skills. The results showed that the students tended to employ various strategies in learning different language skills, but did not frequently use or practice these strategies. Further, vocabulary strategies and pronunciation skills were believed to be effective in conveying and deciphering meaning. These results suggest that language learning strategy training should be provided in STEM education.

Keywords: Language learning strategies, engineering students, English as a foreign language

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Resumen

Este estudio tiene como objetivo proporcionar una profunda evaluación de las estrategias en el aprendizaje del inglés como lengua extranjera utilizadas por los estudiantes de primer año de STEM (Ciencias, tecnologías, ingenierías y matemáticas) y sus propias percepciones sobre el uso de estas estrategias. Los participantes fueron 147 estudiantes de primer año de la carrera de ingeniería de una Universidad en Turquía, cuyas edades oscilaban entre los 18 y 24 años. Se aplicó el instrumento (Young Learners´ Language Strategy Use Survey) para identificar las estrategias de aprendizaje utilizadas por los participantes. Asimismo se seleccionó una submuestra de estudiantes para entrevistarlos sobre las estrategias que utilizan en el proceso de aprendizaje de idiomas. Los resultados mostraron que los estudiantes solían emplear diversas estrategias en el aprendizaje de idiomas, sin embargo no las utilizan con frecuencia. Además, se asume que las estrategias de vocabulario y habilidades de pronunciación son eficaces en la transmisión y comprensión del significado de las palabras. Estos hallazgos sugieren que es necesario proporcionar entrenamiento en estrategias para el aprendizaje de idiomas en la educación en ciencia, tecnología, ingeniería y matemáticas (STEM).

Palabras clave: Estrategias de aprendizaje de una lengua, estudiantes de ingeniería, inglés como lengua extranjera

Resumo

Este estudo tem como objetivo proporcionar uma profunda avaliação das estratégias no aprendizado de inglês como língua estrangeira utilizada pelos estudantes de primeiro ano de STEM (Ciências, tecnologias, engenharias e matemática) e suas próprias percepções sobre o uso destas estratégias. Os participantes foram 147 estudantes de primeiro ano da carreira de engenharia de uma Universidade na Turquia, cujas idades oscilavam entre os 18 e 24 anos. Aplicou-se o instrumento (Young Learners´ Language Strategy Use Survey) para identificar as estratégias de aprendizado utilizadas pelos participantes. Da mesma forma se selecionou uma subamostra de estudantes para entrevistá-los sobre as estratégias que utilizam no processo de aprendizado de idiomas. Os resultados mostraram que os estudantes tinham o hábito empregar diversas estratégias no aprendizado de idiomas, porém não as utilizam com frequência. Além disso, se assume que as estratégias de vocabulário e habilidades de pronúncia são eficazes na transmissão e compreensão do significado das palavras. Estas descobertas sugerem que é necessário proporcionar treinamento em estratégias para o aprendizado de idiomas na educação em ciência, tecnologia, engenharia e matemática (STEM).

Palavras chave: Estratégias de aprendizado de uma língua, estudantes de engenharia, inglês como língua estrangeira

Introduction

Strategies are deliberate observations and mental actions actively employed by learners to improve their language learning, for example, observing how others take notes in a lecture and thinking over one's own background before engaging with a text (Anderson, 2005). The term has also been used interchangeably with behaviors, tactics, and techniques (Ellis, 2008). However, there is no fully agreed upon classification of strategies nor a thorough scientifically validated hierarchy of strategies (Oxford, 1990). Ellis (2008) describes the most widely accepted strategy classifications: those made by O'Malley and Chamot (2010) (e.g. cognitive, metacognitive and social-affective learning strategies), and Oxford (1990) (e.g. direct and indirect strategies).

Further, several researchers have examined the robust link between strategy use and L2 proficiency (e.g. Huang & Nisbet, 2014; Kayaoğlu, 2013; Kouritzin, 2012). However, the literature indicates that very little research has specifically targeted foreign language learning strategies (LLS) used by STEM students in content-based instruction. In this sense, this study aims to bridge this research gap by examining foreign LLS employed by engineering students who had previously received English language instruction and were receiving content-based engineering instruction at a Turkish state university.

The study posed these questions: What strategies do the engineering students frequently employ while learning English-as-a-foreign language and how do they perceive them? Further, the following sub-research questions were asked: What are the strategies students frequently use in learning and employing each language skill (e.g. speaking, listening, reading, writing, vocabulary and grammar)? How do the students perceive their strategy use?

Literature Review

Inventories Used in LLS Research

Several inventories and surveys have been devised to examine language learning strategies (LLS). The most frequently referred to in the literature include Oxford's (1990) Strategy Inventory for Language Learning (SILL). Several research studies on LLS have benefited from SILL (e.g. Demirel, 2012; Patil & Karekatti, 2012) for the purpose of providing "a general picture of the individual learner's typical strategy use, rather than a specific portrayal of the strategies used by the learner on a particular language task" (Oxford, 1999, p.114). It has been used in different language contexts and levels of study

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(Oxford, 1999). The great advantage SILL is to provide reliable and valid data (Anderson, 2005). Likert-type items in the SILL are classified into two main, and six sub-categories of strategies: direct strategies (e.g. memory-related, cognitive, and compensatory), and indirect strategies (e.g. metacognitive, affective, and social strategies) (Oxford, 1999). The Cronbach alpha internal consistency index of the 80-item version of the scale in EFL/ESL or translated contexts is between .94 and .98.The reliability of the 50-item version of the SILL is .89 and .90 when administered in English in EFL contexts (Oxford, 1999).

Another more sophisticated taxonomy is Purpura's (1999), which examines the psychometric properties of cognitive and metacognitive LLS (e.g. comprehending, retrieval and memory strategies) through the applications of the Structural Equation Model approach. The Survey of Reading Strategies (SORS) (Mokhtari & Sheorey, 2002) is another commonly used Likert-type scale, which examines metacognitive strategies used while reading in the target language. It includes three sections: global reading, problem solving reading strategies, and reading support strategies. SORS has a well-established psychometric property and a reliability co-efficiency of .93. Finally, Cohen and Oxford's (2002) Young Learners' Language Strategy Use Survey (LSS) defines strategies regarding language skills. This taxonomy uses 76 items, which are constructed to examine strategy uses in learning language skills such as listening, speaking, reading, writing and other language features including vocabulary and translation.

Content Based Instruction (CBI) and Science, Technology, Engineering and Mathematics (STEM) Education

STEM is an acronym coined in the competitive and modern world and mostly refers to interdisciplinary science, technology, engineering and mathematics education. These four areas are entangled rather than separated into four disciplines because these skills, required in real world applications, are considered for success. STEM education mostly aims to support undergraduate level students in developing the skills needed for a STEM career, which responds to the need for competent professionals in the real world (Reeve, 2014). For a long time, language course content has been selected from a particular profession or academic discipline, such as that of airline pilots or computers scientists. This is because this type of CBI enables the integration of language and content learning, and contributes to the naturalness of content for language instruction (Larsen-Freeman, 2000). Further, CBI "speed[s] up the learning and teaching of the second language in question" (Van Els, 2005, p. 973). This tendency may be a result of the position of English as the language of technology around the globe. The professional world and the labor market in several fields force

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students to have not only technical competencies, but also a strong command of English, the lingua franca of science and technology today (Gimenoa, Seiza, Siqueiraa, & Martínez, 2010).

Research into LLS

Several studies on LLS have been conducted in the last three decades (e.g. Anderson 2003; Cohen 1998; Ellis, 2008; Huang & Nisbet, 2014; Kayaoğlu, 2013; Kouritzin, 2012; Naiman, Fröhlich, & Todesco, 1978; Oxford, 1990). Some mainly investigated learners' engagement towards learning new things, and the strategies they frequently employed to understand, memorize and retrieve information (e.g. Oxford, 1990). Others compared more successful language learners to those less successful, and identified the qualities of good learners in terms of LLS (e.g. Kayaoğlu, 2013).

Typically, there is generally a robust link between strategy use and L2 proficiency. Some learners are better at foreign and second language learning than others even though they receive the same education in the same setting (Lee, 2010). It has also been argued that less successful learners do not generally show considerable progress due to their repeated use of the same strategies. On the other hand, successful language learners possess a variety of strategies ready to be employed in different occasions (Anderson, 2005). Other studies that have frequently examined the relationship between strategy use and language learning performance, and specifically on ESL (Bialystok, 1979; Eslinger, 2000; Rubin, 1975; Vann & Abraham, 1987), and the link between different EFL proficiency levels and strategy use (Ehrman & Oxford, 1995; Oxford & Nyikos, 1989). More recent studies have examined LLS use from different perspectives: studying the link between reading strategy use and reading proficiency among adult ESL learners (Huang & Nisbet, 2014); the link between high and low learners' language learning beliefs and language strategy use (Kayaoğlu, 2013); male and female foreign language learners' LLS (Tercanlıoğlu, 2004); the link between LLS, gender and academic achievement (Demirel, 2012); and the link between explicit metacognitive strategy instruction and EFL reading comprehension (Durgun, 2010).

Regarding STEM education, very few studies have examined LLS used by science and engineering tract students (Cheng, Xu & Ma, 2007; Kouritzin, 2012; Minh & Intraraprasert, 2012; Patil & Karekatti, 2012). Among the first of such studies, Cheng, Xu and Ma (2007) investigated engineering students' LLS while learning English. Questionnaires were used to investigate their strategy use, frequency of strategy use and utilization of learning strategies in practice. The findings indicated that students frequently used more cognitive strategies than social/affective strategies, and metacognitive strategies were

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employed less often. Further, the result suggested that participants believed in the positive effect of strategy use on language learning.

In another study, Minh and Intraraprasert (2012) investigated language-learning strategies used by science-oriented students in Vietnam. Thirty students majoring in science, technology and health science in six different Vietnamese universities were interviewed to extract a LLS inventory to represent the strategies they used. The results suggested two main categories of strategies: language skills enhancement and general language knowledge enhancement.

Following Minh and Intrarapraseet, Patil and Karekatti (2012) examined LLS employed by engineering students and their perceptions on the use of strategies in learning English in the Indian context. The SILL (Oxford, 1990) was used to collect data from 60 engineering students from four engineering colleges. The findings indicate that students prefer metacognitive, cognitive, compensatory and social strategies, but they rarely use memory and affective strategies. Further, students are not aware of the benefits of using LLS to learn English.

Finally, Kouritzin (2012) investigated the similarity between studying foreign languages and the study of STEM subjects in the Canadian context. The findings showed that STEM lead to greater opportunities when compared to foreign language study, regardless of whether the students receive foreign language study or not. It was found that the knowledge of a foreign language was not necessary for business or social success in Canada, and that English was an international language of science.

In the Turkish CBI context, the medium of instruction and the course content related to professional fields are in English at several universities (e.g. BAU, BOUN, ITU). However, in the Turkish research context, to the best of our knowledge, there has been little substantial research that specifically selects its target sample from STEM majors at the undergraduate level. Only Kayaoğlu (2011) has investigated EFL physics-track students' language beliefs and approaches to language learning. The participants were taking foundation EFL courses in a Turkish state university. In this study, the participants responded to Horwitz's (1987) 34-item Beliefs about Language Learning inventory. The results indicated that the students frequently believed that foreign language learning requires a special ability, a good ear, and good memory skills. The students' beliefs and their fixed ideas about aspects of learning foreign language impacted their LLS.

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Briefly, foreign language learners try to employ several different strategies to complete language learning tasks such as reading or writing. In

this sense, they could be successful in completing the tasks if they employed the appropriate LLS (Richard, 1994 cited in Lee, 2010). The above review has shown that very little research has specifically targeted foreign LLS use by STEM students in content-based instruction.

Methodology

Research Design

This mixed methods study used both quantitative and qualitative methods. Specifically, using the convergent parallel design, the researcher concurrently collected the quantitative and qualitative data. The quantitative and qualitative analyses were carried out separately, and then the results were merged to assess the general interpretation (Creswell & Clark, 2011).

Context and Participants

The participants were 147 first-year students studying in different undergraduate level engineering departments at a Turkish state university. Their ages ranged from 18 to 24. Students took an intensive English course in the preparatory program before starting their faculty education in which they attended several content-based courses in English. The medium of instruction and exams were conducted in English. Students were tested using a criterion-referenced framework designed by the School of Foreign Languages at the university. The test included two sections, the first which tested their speaking and writing skills and the second which tested their listening, reading, grammar, and vocabulary skills. All the participants passed this exam based on criterion-referenced assessment. Table 1. shows the participants' profile.

Table 1. Participants' profile

Department	f	%	f	%	age
Software/Computer Engineering	24	16.3	11	7.5	
Metallurgical and Material Engineering	13	8.8	29	19.7	
Automotive engineering	72	49	58	39.5	
Mechanical and Machine engineering	12	8.2	39	26.5	18-24
Electric and electronic engineering	11	7.5	9	6.1	
Energy system engineering.	15	10.2	1	.7	
Total	147	100	147	100	

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Data Collection Instruments

Cohen and Oxford's (2002) Young Learners' Language Strategy Use Survey (LSS) was used in this study. This 76-item taxonomy investigates strategy use in different skills (e.g. listening, speaking, reading writing, and other language features including vocabulary and translation). The reliability checks are positive. The reliability coefficients are: Learning Structure and Vocabulary (r = .85), Speaking (r = .77), Listening (r = .83), Reading (r = .67), and Asking for Clarification (r = .79) (Paige, Cohen & Shively, 2004)

A reliability check for this present study was also conducted. The results showed that the total reliability is very high (r = .925). Further, while the reliability coefficients were over .7 for listening (r=.79), speaking (r=.78), reading (r=.78) and writing (r=.75), the reliability coefficients were lower than .7 for vocabulary (r=58) and translation (r=55).

Data for this study was collected in two phases. First, 147 students responded to the 76 items on the scale. Then, a focus group interview was conducted with a random sub-sample of four students. These participants were randomly selected from volunteers who were studying at different departments to maximize differences among the participants. Six interview questions were pre-determined and directed to the students after they took the survey. The questions related to the strategies used in learning every language skill and their individual experiences. The students discussed their perceptions about strategy use. The interview was conducted in Turkish to maximize participant responses. The interviews were voice recorded and then transcribed.

Data Analysis and Interpretation

A series of descriptive statistical analyses (e.g. the mean and standard deviation) were performed over the quantitative data. The purpose of conducting these statistical analyses was to determine which LLS were most frequently used.

A coding and classifying approach (Gay, Mills & Airasian, 2009) was used for the qualitative data analysis. First, the student responses determined to be pertinent to the research questions were arranged together. They were categorized, and then analyzed according to recurring themes (Huang, Cunningham, & Finn, 2010).

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In terms of the focus groups, the interviews were conducted with the sub-sample of four interviewees in Turkish. First, the voice-recorded interviews were transcribed. Then, the researcher translated the students' responses from Turkish to English. The aim of conducting the interview in the learners' native

language (e.g. Turkish) was to encourage more detailed responses. Finally, the analysis was made based on recurring themes following Gay, Mills and Airasian's (2009) coding and classifying approach. These analyses were used to answer the following research question: How do the students perceive of their strategy use in learning English-as-a-foreign language?

Results

The quantitative results are presented first, followed by the qualitative results. The quantitative analyses included descriptive statistics (e.g. mean and standard deviations of strategy use for each skill). The tables provide the descriptive statistics for the data obtained from responses used in the analysis. Finally, the analysis of the focus group interview is presented.

Quantitative Data Analysis

The quantitative data was used to answer the following research question: What are the strategies students frequently use in learning and practicing each language skill (e.g. speaking, listening, reading, writing, vocabulary and grammar)?

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Table 2. Descriptive statistics for listening strategies

	if the statement really describes you		if the statement isn't like you		if the statement is somewhat you like				general mean	general s.d.
	f	%	F	%	F	%	mean	Sd.		
What I do to listen more…										
1. I listen to the radio in the language.	45	30.6	44	29.9	58	39.5	,904*	0,84		
2. I watch TV shows in the language.	46	31.3	35	23.8	66	44.9	,789	0,87		
3. I go to movies that use the language.	43	29.3	41	27.9	63	42.9	,850	0,84		
4. I listen to the language if I am in a or go see movies in the language.	54	36.7	29	19.7	64	43.5	,762	0,90		
5. If I hear people speaking the language, I listen	47	32.0	41	27.9	59	40.1	,878	0,85		
What I do to understand sounds										
6. I find sounds in the language that are like sounds in English.	41	27.9	38	25.9	68	46.3	,796	0,84		
7. I try to remember unfamiliar sounds I hear.	49	33.3	27	18.4	71	48.3	,701	0,89		
8. I ask the person to repeat the new sound.	41	27.9	24	16.3	82	55.8	,606	0,87		
9. I listen to the rise and fall of sounds (the music of the language).	56	38.1	25	17	66	44.9	,721	0,91	-781	.0825
What I do to understand what I hear										
10. I listen for the important words.	48	32.7	44	29.9	55	37.4	,925*	0,84		
11. I listen for what seems interesting.	49	33.3	25	17	73	49.7	,674	0,90		
12. I listen for words that are repeated.	43	29.3	32	21.8	72	49	,728	0,87		
What I do if I still don't understand what someone says:										
13. I ask the person to repeat.	43	29.3	42	28.6	62	42.2	,864	0,84		
14. I ask the person to slow down.	44	29.9	35	23.8	68	46.3	,776	0,86		
15. I ask a question.	48	32.7	30	20.4	69	46.9	,735	0,88		
16. I guess the meaning from the person's tone (such as angry or happy).	48	32.7	35	23.8	64	43.5	,803	0,87		
17. I guess the meaning from how the person moves or stands.	52	35.4	32	21.8	63	42.9	,789	0,88		
18. I guess the meaning from what I heard before.	55	37.3	28	19	64	43.5	,755	0,90		

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Table 2 provides the detailed descriptive statistics for the responses given for the listening strategy category. Both the mean and standard deviations are very similar across each strategy item, indicating that students employ similar listening strategies. The mean scores are close to 1.0, indicating that the students use these listening strategies to some extent. The standard deviations are slightly below 1.0, indicating that the students employ similar listening strategies. Further, item #1 and item #10 received higher mean scores, indicating that the students mostly listen to the radio and pay attention to important words when listening.

Table 3. Descriptive statistics for vocabulary strategies

What I do to memorize new words	if the statement really describes you		if the statement isn't like you		if the statement is somewhat you like				General mean	General s.d
	f	%	F	%	F	%	mean	Sd		
19. I group the words by type (e.g.. nouns. verbs. adjectives).	54	36.7	28	19	64	43.5	,748	.89968		
20. I match the sound of the new word with the sound of a word I know.	42	28.6	25	17	80	54.4	,626	.87655		
21. I use rhymes to remember new words.	58	39.5	25	17	64	43.5	,735	.91320		
22. I make a picture of new words in my mind.	56	38.1	21	14.3	70	47.6	,667	.92406	.704	.0582
23. I write the new word in a sentence.	44	29.9	32	21.8	71	48.3	,735	.86816		
24. I write the new word on a card.	36	24.5	36	24.5	75	51	,735	.83030		
25. I go over new words several times at first.	47	32	22	15	78	53.1	,619	.90077		
26. Later I go to remind myself about words I learned earlier	43	29.3	35	23.8	69	46.9	,769	.85769		

Table 3 provides the detailed descriptive statistics for the responses given for vocabulary strategy use. Both the mean and standard deviations are very similar across strategy items, indicating that each student employs similar vocabulary strategies. The mean scores are approximately 1.0, indicating that the students use these vocabulary strategies mentioned above in the Table. Again, the standard deviations are slightly below 1.0, indicating that the students employ very similar vocabulary strategies.

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Table 4. Descriptive statistics for speaking strategies

	if the statement really describes you		if the statement isn't like you		if the statement is somewhat you like				General mean	General s.d
	f	%	F	%	F	%	mean	sd		
What I do to practice speaking										
27. I make the sounds of the language until I can say them well.	57	38.8	27	18.4	63	42.9	,755	.90567		
28. I imitate the way native speakers talk.	56	38.1	35	23.8	56	38.1	,857	.87586		
29. I say new expressions over to myself.	48	32.7	32	21.8	67	45.6	,762	.87798		
30. I practice using new grammar forms when I talk.	52	35.4	29	19.7	66	44.9	,748	.89392		
What I do to talk with other people:										
31. I start conversations.	53	36.1	25	17	69	46.9	,701	.90757		
32. I change the subject if I don't have the words I need.	53	36.1	26	17.7	68	46.3	,714	.90459		
33. I plan what I am going to say.	55	37.4	28	19	64	43.5	,755	.90072	.761	.0630
34. I ask the other person to correct me when I talk.	57	38.8	33	22.4	57	38.8	,837	.88364		
When I can't think of a word or phrase I want to say:										
35. I ask the person to help me.	49	33.3	30	20.4	68	46.3	,741	.88575		
36. I try to say it a different way.	49	33.3	29	19.7	69	46.9	,728	.88858		
37. I use words from my own language.	50	34	29	19.7	68	46.3	,735	.89057		
38. I use words from my own language, but utter them with sounds from the new language.	51	34.7	24	16.3	72	49	,674	.90660		
39. I move my hands or body so the person will understand me.	51	34.7	40	27.2	56	38.1	,891	.85540		

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Table 4 provides the detailed descriptive statistics for the responses given for speaking strategy use. Both the mean and standard deviations are very similar across strategy items, indicating that students employ similar speaking strategies. The mean scores are somewhat near 1.0, indicating that the students use above mentioned speaking strategies. Again, the standard deviations are slightly below 1.0, indicating that the students employ very similar speaking strategies.

Table 5. Descriptive statistics for reading strategies

	if the statement really describes you		if the statement isn't like you		if the statement is somewhat you like				General mean	General s.d
	f	%	F	%	F	%	Mean	sd		
What I do to read more										
40. I read a lot in the language.	52	35.4	28	19	67	45.6	,735	.89699		
41. I read for fun in the language.	49	33.3	26	17.7	72	49	,688	.89673		
42. I find things to read that interest me.	51	34.7	35	23.8	61	41.5	,823	.87319		
43. I look for things to read that are not too hard	57	38.8	24	16.3	66	44.9	,714	.91580		
What I do to understand what I read										
44. I skim over a reading to get the main idea.	56	38.1	38	25.9	53	36.1	,898	.86380		
45. I look for important facts.	64	43.5	25	17	57	39.5	,850	1.230*		
46. I read things more than once.	54	36.7	31	21.1	62	42.2	,789	.88968		
47. I look at the pictures and what is under the pictures.	54	36.7	30	20.4	63	42.9	,776	.89308		
48. I look at the headings.	40	27.2	35	23.8	72	49	,748	.84818	.763	.0830
49. I think about what will come next in the reading.	49	33.3	16	10.9	82	55.8	,551	.92006		
50. I stop to think about what I just read.	51	34.7	29	19.7	67	45.6	,742	.89235		
51. I underline parts that seem important.	48	32.7	27	18.4	72	49	,694	.89167		
52. I mark the reading in different colors to help me understand.	51	34.7	29	19.7	67	45.6	,741	.89235		
53. I check to see how much I understood.	80	54.4	24	16.3	43	29.3	,871	.88243		
What I do when I don't understand what I read										
54. I guess the meaning by using clues from other parts of the passage.	55	37.4	31	21.1	61	41.5	,796	.89042		
55. I use a dictionary to find the meaning.	48	32.7	34	23.1	65	44.2	,789	.87207		

Table 5 provides the detailed descriptive statistics for the responses given for reading strategy use. Both the mean and standard deviations are very similar across strategy items, indicating that students employ similar reading strategies. The mean scores are somewhat near 1.0, indicating that the students use the above mentioned reading strategies. Again, with the exception of item

#45, standard deviations are slightly below 1.0, indicating that the students employ very similar reading strategies and differ only in looking for facts to understand what they have read.

Table 6. Descriptive statistics for writing strategies

	if the statement really describes you		if the statement isn't like you		if the statement is somewhat you like				General mean	General s.d
	F	%	F	%	F	%	mean	sd		
What I do to write more										
56. If the alphabet is different. I practice writing it.	62	42.2	44	29.9	41	27.9	1,020*	.82761		
57. I take class notes in the language.	58	39.5	27	18.4	62	42.2	,762	.90619		
58. I get write other notes in the language.	57	38.8	26	17.7	64	43.5	,742	.90911		
59. I write letters to other people in the language.	44	29.9	36	24.5	67	45.6	,789	.85769		
60. I write papers in the language	56	38.1	26	17.7	65	44.2	,735	.90829		
What I do to write better										
61. I plan what I am going to write.	48	32.7	43	29.3	56	38.1	,912	.84223		
62. I use a dictionary or glossary.	46	31.3	36	24.5	65	44.2	,803	.86224		
63. I read what I wrote to see if it is good.	52	35.4	34	23.1	61	41.5	,816	.87761	.791	.0816
64. I ask someone to correct my writing.	57	38.8	30	20.4	60	40.8	,796	.89496		
65. I rewrite what I wrote to make it better.	45	30.6	27	28.4	75	51	,674	.88317		
66. I use the spell checker on the computer.	52	35.4	27	18.4	68	46.3	,721	.89999		
67. I use the grammar checker on the computer.	48	32.7	34	23.1	65	44.2	,789	.87207		
What I do if I cannot think of a word or phrase I want to write										
68. I ask someone for the word or phrase I need.	57	38.8	33	22.4	57	38.8	,837	.88364		
69. I try to say it in a different way.	58	39.5	25	17	64	43.5	,735	.91320		
70. I use words from my own language.	53	36.1	29	19.7	65	44.2	,755	.89527		
71. I use words from my own language but add new endings to those words.	57	38.8	28	19	62	42.2	,769	.90217		

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Table 6 provides the detailed descriptive statistics for the responses given for writing strategies. Both the mean and standard deviations are very similar across strategy items, indicating that students employ similar reading strategies. The mean scores are somewhat near 1.0, indicating that students use the above mentioned reading strategies. Again, standard deviations are slightly below 1.0, indicating that students employ very similar reading strategies. The mean score is over 1.0 for the item #56, indicating that they mostly prefer practicing writing the alphabet when they know it is different.

Table 7. Descriptive statistics for translation strategies

	if the statement really describes you		if the statement isn't like you		if the statement is somewhat you like				General mean	General s.d.
	F	%	F	%	F	%	mean	sd		
What I do when I translate										
72. I plan what I want to say or write in my language and then translate it into the new language.	47	32	40	27.2	60	40.8	,864	.85147		
73. I translate when reading to make sure I understand it.	51	34.7	34	23.1	55	37.4	,809	.87655		
74. While I am listening to someone, I translate parts of what they say into my own language to remember it.	58	39.5	34	23.1	55	37.4	,857	.87952	.871	.0545
What I do to think in the new language										
75. I put my language out of my mind.	50	40.1	34	23.1	54	36.7	,864	.87909		
76. I try to understand without translating.	57	38.8	42	28.6	48	32.7	,959	.84582		

Table 7 provides the detailed descriptive statistics for the responses given for translation strategies. Both the mean and standard deviations are very similar across strategy items, indicating that each student employs similar translation strategies. The mean scores are somewhat near 1.0, indicating that the students use these above mentioned translation strategies. Again, standard deviations are slightly below 1.0, indicating that students employ very similar translation strategies.

Briefly, the results are quite similar for all strategies. Although the descriptive statistical results suggest that the students use the above language LLS similarly to some extent, they do not apply all these strategies with the same frequency.

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Qualitative Data Analysis

Regarding the profile of the participants in the focus groups, Student B and Student D were mechanical engineering majors, Student A was a mechatronic/mechanical engineering major, and Student C was a computer/software engineering major. When asked about their self-assessment of their L2 levels, the four students expressed that they had an intermediate level of English proficiency.

The analysis of the students' preferences on speaking skills indicated that they emphasized appropriate vocabulary choice and pronunciation.

I try to pronounce words accurately and clearly. [Student A]

First I check the meanings of words and then try to speaking using these words. [Student B]

Generally I watch films and find words that I do not know. Then, I try to speak. [Student C]

I generally try to pronounce words accurately. [Student D]

The students mostly reported that they try to understand spoken language using their lexicon and well-known words. A student emphasized that pronunciation is a clue to understand what is heard.

I try to understand the whole speech departing from the meanings of each word that I know on the subject. [Student A]

I try to solve pronunciations. [Student B]

I learn new words and then try again to understand. [Student C]

I try to understand depending on the meaning of words that I know. [Student D]

For reading comprehension, the students mostly prefer to employ a bottom-up strategy. In other words, they first focus on each word that they are acquainted with and then relate word meanings with each other based on the text context. A student reported that he/she first attempts to use a dictionary to find the meaning of unknown or new words and then reads the text a few times.

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I try to understand a text depending on the meaning of words that I know. [Student A]

I select words then relate them with the whole text to understand it. [Student B]

I find the meanings of words that I do not know well. Then, I try to understand the text by reading it repeatedly. [Student C]

I depart from the meanings of each word to understand a text. [Student D]

Regarding writing skills, the students mostly prefer to employ pre-writing strategies and attempt to find the meanings of new words. They then construct messages into sentences before writing.

First I imagine, then I carefully try to construct sentences using basic vocabulary based on my proficiency level. [Student A]

I use vocabulary strategically. [Student B]

First I design what I am going to write then try to write. [Student C]

First I find vocabulary that I do not know and then I focus on messages conveyed with sentences. [Student D]

When it comes to the challenges they experience for each skill, Student B and Student D reported that the most challenging skill is pronouncing words correctly. They try to cope with this through repeated practice. Student A reported that vocabulary retention poses a challenge for him/her and to overcome this sort of problem he/she prefers to learn vocabulary using sentences in context and using visual aids.

I forget the meanings of words that I learnt earlier, therefore I prefer to learn words using them in sentences and with visual aids rather than writing. [Student A]

I experience challenges with pronunciation yet I cannot do anything. [Student B]

While learning English I experience challenges in speaking and writing; so, I watch films and read books in English. [Student C]

I face difficulty in pronunciation, so I usually do exercises and revisions but I do not think that they are effective. [Student D]

Their opinions regarding how English should be learnt and taught are diverse. Student A states that using English in daily life may impact learning. Teachers should consider students' proficiency levels and help students to lean new vocabulary rather than teaching them only grammar. Student B emphasizes that teachers should avoid revisions. Student C gives utmost importance to speaking. Student D believes that teaching the same things repeatedly does not improve student language skills.

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I think that we should place English in many aspects of our lives; as a result, we will encounter them continuously and then we would learn permanently. While teaching English, teachers should consider students' proficiency levels and help them to learn new vocabulary rather than grammar. [Student A]

While teaching English, revisions should be avoided. [Student B]

While teaching English, I think students should be helped to speak frequently. [Student C]

While teaching English, there is a monotonous situation and therefore I do not think that such a teaching will not contribute to learning. [Student D]

Briefly, although the students mostly use language learning strategies, they employ various strategies for different language skills. For speaking, they place emphasis on appropriate vocabulary choice and pronunciation. For writing skills, they mostly employ pre-writing strategies and attempt to find meanings of new words rather than construct messages in sentences before writing. Further, they have reported that vocabulary retention and pronunciation are the most challenging skills, and they follow rote-learning tactics for accuracy (e.g. repeating until remember). They try to cope with these problems by employing different strategies. Also, they suggest that language learning and teaching should be aligned with the students' learning styles and their learning pReferences.

Conclusion

The quantitative data analysis suggests that the engineering students employ various strategies in learning different language skills. The qualitative data analyses explained their strategy use. First, interview data analyses showed that pronunciation was both the most challenging and important skill. When speaking and listening in English, the students give importance to pronunciation strategies. Further, to be competent in pronunciation, practicing is perceived as a good strategy for accuracy.

Second, the students also considered vocabulary to be a challenging skill and a key factor in reading, listening, and writing skills. Appropriate vocabulary choice is reported to be a good strategy for speaking skills. Further, they also reported that they could understand spoken language better depending on the number of the words they knew in what they heard. To understand a written text, the students mostly began by focusing on each word they knew and then guessed the meanings of unfamiliar words based on context. Interestingly, the students related their ideas on language learning and teaching with their strategy use. That is, they mostly aligned their strategy use with their expectations regarding language learning and teaching. As such, they believed that using language skills in real-life contexts may be effective. Further, vocabulary was believed to be more important than grammar. Finally, they believed that revisions regarding grammar were not good for language learning progress.

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There are two major limitations that need to be acknowledged and addressed regarding this study. First, scant interview data might have limited the qualitative results of the study. Instead, more sophisticated qualitative methods could be used in data collection. For example, concurrent data could be collected through think-aloud protocols to provide deeper evidence of what students think while employing strategies. Several strategy studies have used this data collection procedure (e.g. Alhaisoni, 2012; Ohly, 2007). Additionally, observations may be a viable alternative to interviews. Second, this study collected data only from engineering students. Participants from different fields and from different educational levels in the STEM context may lead to different results.

In light of the above limitations, the following suggestions are proposed. First, identifying strategies and providing strategy training can foster interlanguage development indirectly (Ellis, 1997). The engineering students in this study reported that vocabulary was both of paramount importance in reading, listening, and writing, was a challenging skill as well. Vocabulary strategy training can be implemented within teaching programs. This suggestion is supported by previous research (e.g. Demirel, 2012). As reported by Ellis (1997). The results of the research on training on strategies and vocabulary learning suggested that different ways of meaning associations with new words or linking L1 words to a "mental image" that encompasses the meaning of L2 words can contribute to retention and recall. Other research has also suggested that training teachers to teach students language learning strategies would contribute to students' development (Demirel, 2012). Training students to use strategies plays an important role in fostering learner autonomy; learners become more autonomous as they take responsibility of their own learning (Ellis, 2007).

Second, the qualitative data of this study did not show any sign of students' awareness of the positive impact of strategy use on their language development. An earlier study found that engineering students are not well aware of the benefits of using LLS in learning English (Patil & Karekatti, 2012) even though another study indicated that students believe that strategy use has positive effects on language learning (Cheng, Xu& Ma, 2007). There are still contradictions among the results of studies. Some research has suggested that effective LLS training should be applied explicitly, integrated into regular class work activities (e.g. Chamot, 2004). Therefore, explicit strategy use training could be applied in STEM education contexts.

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Overall, from the perspective of educational practice, this paper provides new experimental data on the topic. The research results might be included in the materials for teachers' continuing professional development programs and might be taken into account within foreign language course planning

procedure as far as STEM education is concerned. Finally, comparing students' EFL proficiency levels and strategy use based on gender is not within the scope of this study. Further research should include participants with varying EFL proficiency levels from different fields of STEM education.

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