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Measuring Indonesian Students' Lexical Diversity and Lexical Sophistication

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Abstract

The aim of the present study was to look at a description of Indonesian EFL students' vocabulary knowledge. The focus was on their lexical diversity (how many different words students used) and lexical sophistication (how many advance words students used) in the English production, which is learnt by them as a foreign language. Their vocabulary knowledge was assessed using the D_tools and P_Lex software for the analysis. These statistical programs describe students' detail computation results in both number and graph. Ten participants' word production through a story-telling test was recorded and analyzed to look at their D and Lambda value. Based on the results gathered, it can be concluded that as foreign language learners, lower level of proficiency participants could produce more lexically rich texts than higher level participants and vice versa.

Keywords

Vocabulary knowledge, lexical diversity, lexical sophistication, word production

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Introduction

As vocabulary plays important role in second language learning that provides a base for learners to perform all skills in a language, both receptive and productive, study on evaluating vocabulary of second language (L2) learners has been considered necessary. Moreover, due to its importance for communicative competence and the acquisition process, Schmitt (in Juanggo, 2018) believes that second language learners can express their ideas and understand information in the target language precisely with adequate vocabulary knowledge. Azodi, Karimi, and Vaezi (2014) additionally explained that in comprehending and understanding the inferences of a normal text, learners who know less than 1000 word families would have difficulty. The similar problem will be experienced when they listen to a speech. They would be unable to have fluent comprehension since they cannot recall the words quickly.

Vocabulary knowledge is also widely accepted as the main prerequisite of bilingual children. Laufer (1995) indicates that vocabulary mostly becomes a factor that differentiates L2 learners and native speakers that most of L2 learners use a quite limited range of vocabulary compared to native speakers both in oral or written language production. Vocabulary knowledge also determines the level of language proficiency or language level among L2 learners themselves. The development of vocabulary is regarded as a marker of the language progress and an approximation towards native speaker's lexical system (Laufer, 1995). This means when the range of vocabulary expands, the L2 proficiency will relatively improve.

Vocabulary tests mostly consist of a small sampling of words that vary in familiarity or a task that requires optional synonym or definition and most clinical receptive/productive tests instruct the examinee to respond to a picture prompt with a verbal label, or vice versa (Deane et al., 2014). Additionally, Webb (2002) stresses the importance of different tasks to assess both productive and receptive vocabulary knowledge. Therefore, it is crucial to fall back on reliable measures that allow researchers not only understand the effects of tasks more precisely, but also to compare their results and establish valid forms of assessment that could also be useful for practitioners.

Practically, teachers frequently use vocabulary tests to broadly measure students' vocabulary improvement that typically can be administered once or twice a year to estimate overall vocabulary growth, which sometimes is not enough time for improvement. They have a burden of responsibility in a limited span both to teach and to evaluate the feedback from students. It reveals that teacher need shortest span of time to discover development in students' receptive or productive vocabulary if progress has been made. Statistical tools in measuring students' vocabulary knowledge and progress will help teachers to be easier in administering the test and analyzing the result. Therefore, the current study focused on giving a description of examining vocabulary knowledge by utilizing D_tools and P_Lex program which compute raw data of vocabulary production from participants and reveals their detailed statistical measurement of their lexical variation and lexical difficulty.

Literature Review: Assessing Vocabulary

The majority of researchers in the field of second language teaching agree that vocabulary knowledge involves degree of knowledge that should be constructed as a continuum consisting of a number of levels and dimensions of knowledge (Shen, 2008).

Nation (2001) distinguishes between three main areas of knowledge of a word, which are then each of them is subdivided into another three areas of knowledge. Firstly, it is possible to know the word form (spoken, written and word parts). Secondly, the ability to know the meaning of words (the connection between the form and the meaning, the concept and its referents, and the associations connected with a particular word). Last, knowing the use of the words (how the word functions grammatically, its collocations and any possible constraints on use). Each of these nine sub-areas can then be known either receptively or productively.

For evaluation, breadth and depth knowledge are two major dimensions of interest in assessing the vocabulary knowledge of learners (Anderson & Freebody in Azoli et al., 2014). The first one is assessing vocabulary size of learners, which is referred to as assessing breadth of knowledge. It deals with the number of words that a learner knows at least some superficial knowledge. The second one is assessing quality of vocabulary knowledge, which is referred to as assessing depth of knowledge. It focuses on learners' knowledge of various aspects of a given word or how well the learner knows the word.

Breadth vocabulary knowledge assessment concern with the number of words that learners know. For native speakers, as mentioned by Shen (2008), it would be a measurement of the number of words that they know in some absolute sense. While, the aim of second language learners vocabulary measurement is commonly focuses on their knowledge of items in a specified list of relatively high frequently words. Whereas, depth vocabulary knowledge assessment mostly concerns with useful higher frequency words. Therefore, learners need to have more than just a superficial understanding of the meaning, the assessment should cover several components such as pronunciation, spelling, meaning, register, morphological, syntactic, and collocation properties.

Practically, research based on testing the breadth and depth of vocabulary by using the measures explained so far mainly focuses on the receptive aspect of L2 vocabulary. Related to free production, lexical richness is specifically used as an umbrella term for other, more specific terms. Measuring lexical richness is generally concerned with how many different words are used in a text (spoken or written). Lexical richness can be introduced in many forms represented in lexical density, lexical originality, lexical variation and lexical sophistication (Laufer & Nation, 1995). Lexical richness has already been investigated both in applied linguistics and in the context of word frequency distributions. In applied linguistics, a number of tests have been developed for measuring the lexical usage of children or second language learners (Read, 2000).

Lexical richness measures are used to evaluate the lexical proficiency level of a child or learner, comparing their lexical richness with an external reference point. Lexical richness measures have been a concern both in applied linguistics (see e.g. Read, 2000) and in the context of word frequency distributions (Baayen, 2001). In applied linguistics, lexical tests mostly focus on child language acquisition or on the extent of vocabulary acquisition of (typically L2) language users, while word frequency distributions statistically model the vocabulary in (a collection of) longer texts. The most widespread tests are based on the concept of vocabulary diversity, which is assessed using a type-token ratio or mostly known by linguists as TTR. This test refers to the ratio of different unique words to the total number of words (Johansson, 2009). The definition clearly refers to different word types represented in the level of uniqueness. It is an essential part in assessing learners language proficiency particularly vocabulary knowledge.

However, lexical richness is properly investigated in texts which have a similar or close range in length in order to address the issue of validity. Furthermore, as vocabulary is one of the vital parts of any given language whether a native language or otherwise, the learner's lexical reservoir determines the uniqueness of one's vocabulary which reflects the level of proficiency. What we are implying is that lexical richness proves to be a successful, but not an exclusive, predicator of proficiency. As such, lexical density can be used as an asset to investigate issues in SLA within a dynamic systems theory (DST) framework, for instance, to investigate the development of lexical richness considering age, gender, type of instruction, learning or teaching strategies and other variables as factors influencing the development of lexical richness.

Before doing any form of investigation related to lexical richness, it is crucial to define what a word is, because the purpose, the method and the tools of investigation depend on what we mean by 'word'. It is also of crucial importance to make a clear distinction between the four types of lexical richness to establish the justification and the limitations of this paper. The term 'word' in four distinguishable meanings: a word family, a lemma, a type and a token, ordered from the most general to the most specific (Nation, 2001; Read, 2000).

A word family is a broad term that refers to different parts of speech in which regular and irregular derivatives are incorporated. In other words, a word family is a group of words that share a common base or root onto which many prefixes and suffixes can be attached (e.g. write, writes, rewrite, writer, writing, typewrite, underwrite, writeable, etc.). A lemma is the base form under which all inflections are associated. In other words, a lemma is a group of words that have a grammatical association (e.g. drink, drank, drunk, drinking). A type refers to the number of unique words in a text. In other words, a type is different from a token in the sense that the former only considers the number of words disregarding the repetitions in contrast to the latter. A token considers the number of all words in a text including repeated ones.

Regarding lexical richness, Laufer and Nation (1995) introduce four distinguishable types of lexical richness: 1) Lexical originality (LO) focuses on the number of unique tokens in a given text; 2) Lexical sophistication (LS) focuses on the number of advanced words in a given text; 3) Lexical variation (LV) focuses on the ratio of the different words to the ratio of repeated words; and 4) lexical density (LD) which focuses the percentage of lexical words in a given text (i.e., nouns, verbs, adjectives, adverbs). Lexical diversity (LD) and lexical sophistication (LS) are two among those measures used to assess vocabulary knowledge by evaluating L2 learners' production. LD (or lexical variation) and LS (or lexical difficulty) are the two aspects of lexical richness which can indicate how well an L2 learner actively uses the vocabulary. Read (in Johanson, 2014) mentions that lexical richness is a multifaceted construct which can be described in terms of lexical density (ratio between function and lexical words), LD (type/token ratio), LS (ratio between lexical tokens and advanced lexical tokens) or the proportion of lexical errors in the texts. All these measures are based on an analysis of learner texts, focusing on vocabulary use from varying perspectives, either in terms of number and types of lexical items (Read in Johansson, 2008). In the context of word frequency distributions, lexical richness has also been studied. Interestingly, Baayen (2001) has indicated that all mathematical TTR transformations proposed (including the Index of Guiraud, Herdan & Uber) are text length dependent. To be more specific, they are unable to capture the specific structure of the lexicon, which is characterized by a Large Number of Rare Events (LNRE): while a small number of words are very frequent, the majority of words occur only a few times, even in large token samples.

A number of studies have been conducted to examine the lexical richness considering many factors as predicators of lexical richness. Gregori-Signes and Clavel-Arroitia (2015), conducted a study to investigate the lexical density and lexical diversity of written texts of two groups in their first academic year at the Universitat de València whose proficiency level is established as B1 compared to a third group whose aim is to obtain a C2 proficiency level. The researchers in this study wanted to examine the reliability of the measurement tools for predicting lexical richness. The findings of this study suggested that the lexical richness measurement tools were stable in predicting the lexical richness of two similar groups compared to another different group.

In another study conducted to measure lexical diversity, lexical sophistication and lexical density in narratives written by three groups of Czech EFL learners, common measurements of lexical richness were used to examine the reliability of the measurements and the correlations between the three types of lexical richness (Šišková, 2012). The measurements prove to be reliable in measuring the learners' lexical richness of the three types in the sense that these measurements detected the differences among the three learners' groups. The findings of the study also suggest that there are degrees of correlation between the three types of measurements of lexical richness. The strongest correlation was found between measurements of lexical diversity and lexical sophistication. A weak correlation was found between measurements of lexical diversity and lexical density. And finally, no correlation between measurements of lexical density and lexical sophistication. The implications of this study refer to the correlational degrees, which depend on the nature of application. In other words, the strength or weakness of the correlation depends on the way in which these measurements are conducted. A study of this sort is also recommended because it provides the researchers with certain implications, which might assist them in choosing the measurements that they see fit for the task of investigation considering many factors such as the gender, age and the proficiency level of participants.

Moreover, lexical richness has been measured by researchers by measuring the ratio of words types to word tokens (TTR) which the number of different words as a ratio of the total number of running words in a text. However, TTR has its weakness since it is sensitive to text length that the rate at which new word types appear in a text decreases as the text size increases. Therefore, Malvern and Richards (in Meara & Miralpeix, 2017) proposed D_tools as a program that computes a statistic reflecting richness of a text. D is considered to be more informative than TTR as it allows measuring a range of token sizes for each speaker or writer rather than single value of TTR. Miralpeix (2008) mentions that D_tools is designed to compute D values for short texts. D_Tools computes a statistic that reflects the lexical richness of a text. Specifically, D_Tools computes the value of Malvern and Richards' *vocd* statistics. D_Tools makes a report on your text which looks like the figure on the next page. D_tools works by taking a series of samples from the text and computing a Type-Token value for each of these samples. The program takes 100 samples of 35 words and computes a mean TTR for these samples. Then it takes 100 samples of 36 words and computes a mean TTR for those samples. This process is repeated with 100 samples of 37 words, 38 words, 39 words, and so on up to 50 words. D_Tools then uses Malvern and Richards' formula to find a value of D. It computes and averages TTRs at each point and matches the curve: TTR = (2/DN) [(1 + DN) ½ – 1].The best match between the two curves, which is calculated using a least-square algorithm, is the D value of our text. D_tools does not automatically lemmatize the text because. For example, do, does, and doing will be treated as different type unless we edit the input file and replace all instance of does and doing by do.

However, the D_tools does not assess LS. LS has traditionally been operationalized as the diversity of the words used in a text (e.g., the number of unique words in a text divided by the total number of a text) or by the average reference-corpus frequency of words in a text. Productive lexical knowledge is frequently assessed by examining the LS of a speaking or writing sample, which is generally related to the diversity and/or the relative difficulty and often based on corpus frequency counts of the lexical items in a text (Kyle & Crossley, 2016). P_Lex, therefore, uses as an assessment program that was designed as a way of assessing the vocabulary used by L2 learners when they produce texts and provides a single overall score that is easy to understand and transparent in the computation. P_Lex, therefore, looks at the distribution of difficult words in a text, and returns a simple index that tells us how likely the occurrence of these words is. The program divides a text up into ten-word segments and counts the number of "difficult" or "unusual" words that appear in each segment. The score it generates is the mean number of difficult words in each segment. P_Lex works with short texts in English and is mainly intended to process short texts generated by L2 learners. As such, it works best with texts that are not longer than 300 words. The program will handle texts that are longer than this, but the displays are designed for shorter texts. We will need to do some editing work on the texts that you want to process using P_Lex. The main problem that you will have to deal with concerns errors. There are two possibilities here: to leave the errors intact or to correct them. Since P_Lex uses an inbuilt dictionary that will not recognise incorrectly spelled words, it is probably best to correct errors of this sort.

P_Lex works as follows. Suppose we want to process text T. First, we divide T into a set of 10 word segments, ignoring punctuation. Next, we categorise the words in each segment in terms of their objective frequency. The current version of P_Lex is based on Nation's (1984) word lists. It treats all words occurring in the first 1000 word list as 'easy'. Proper nouns, numbers and geographical derivatives are also categorised as 'easy' words. All other words are categorised as 'hard'. Next, we count the number of infrequent words in each segment, and calculate the number of segments containing zero infrequent words, the number of segments containing one infrequent word, the number of segments containing two infrequent words, and so on. This gives as a P_Lex profile for text T. The programme, which is based on the assumption that difficult words are infrequent occurrences in a text, calculates the theoretical Poisson curve which most closely matches the actual data produced from the text. The value obtained is called Lambda, and indicates the degree of lexical sophistication the text presents. Lambda describes that the text contains principally high – frequency words, while a higher value is an indication of more sophisticated vocabulary used by L2 learners.

Methodology

This study was aimed to give a description of examining lexical diversity and lexical sophistication of English (as a foreign language) vocabulary production by utilizing D_tools and P_Lex program. The software computes raw data of vocabulary production from participants and reveals their detailed statistical measurement of their lexical variation and lexical difficulty. In this research, the participants were ten Indonesian students of a public university in Jambi, Indonesia. They have been learning English as their foreign language at school for more than eight years from the seventh grade. But in the present study, researchers focused more on the participants' language proficiency level according to Common European Framework of Reference for languages (CEFR).

There are three dimensions of vocabulary assessment are 1) discrete - embedded dimension, 2) selective - comprehensive dimension and 3) context-dependent – context - independent dimension. According to Read (2000), discrete tests assess vocabulary as a construct independent from other aspects of language ability, while an embedded measure of vocabulary "is the one that contributes to the assessment of a larger construct" (p.9). For example, vocabulary assessment is embedded in oral proficiency interviews, in the assessment of the performance of language tasks of the learner. In collecting the data, Zhang (2014) also proposed that an interviews or story telling is a type of vocabulary assessment that can be used by researcher in order to measure lexical richness in oral proficiency from a more embedded, comprehensive and context-dependent dimension. Therefore, in the present study, we use a children storybook written by Mercer Mayer. This storybook consists of twenty-nine pages of pictures describing the sequels of the story. Participants were asked to spontaneously telling a story (Frog story) that was showed by the researcher in a given time (fifteen seconds for each sequel). They should produce words based on the picture of each page/ sequel and they were recorded. Then, the records of participants story telling were transcribed as the raw data to be analyzed.

The present research uses software proposed by Meara and Bell (2001) for the analysis due to the availability of the software and the type of results that it provides. D_tools was used to measure participants' lexical diversity and P_Lex was used to measure participants' lexical sophistication. The report of D_tools shows the mean TTR score for each of the 15 sample sets (data), and the values that Malvern and Richards' formula generates for the best value of D (model). The graph shows the data values (blue) and the model values (red). Normally these two sets of values will be almost identical. The report also details the number of words counted, the best estimate of D and an error score. The error score indicates how closely the model data matches the actual data. The report of P_lex tells you the name of the text it has analysed, how many 10-word segments have been processed by the program, and what proportion of the ten-word segments contain N difficult words. It also reports a value (lambda) which summarises the data presented in the table. This is the value that normally used to summarise a P_Lex analysis.

Findings

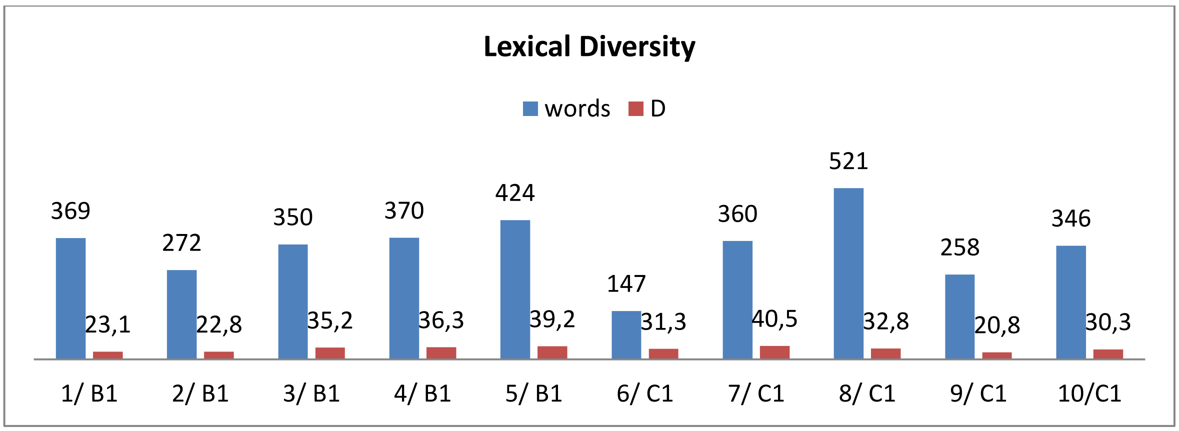
Lexical richness of a speaker, in quantitative sense, refers to the amount of vocabulary that the speaker freely uses in discourse. It reflects the speaker's ability and skills in maneuvering the basic units of speech. The richer lexicons used in the discourse, the higher degree of variations and sophistications perceived. Each of the transcription of participants' story telling production was copied and insert into the software using D_tools and P_Lex programs. The results are presented in the following table:

Table 1. *D_tools results*

Participant/ Proficiency	Total words	D (lexical diversity)	Error
1/ B1	369	23,1	0.001
2/ B1	272	22,8	0
3/ B1	350	35,2	0
4/ B1	370	36,3	0.001

5/ B1	424	39,2	0
6/ C1	147	31,3	0
7/ C1	360	40,5	0.001
8/ C1	521	32,8	0.001
9/ C1	258	20,8	0.001
10/C1	346	30,3	0

Figure 1. *Lexical diversity of participants*



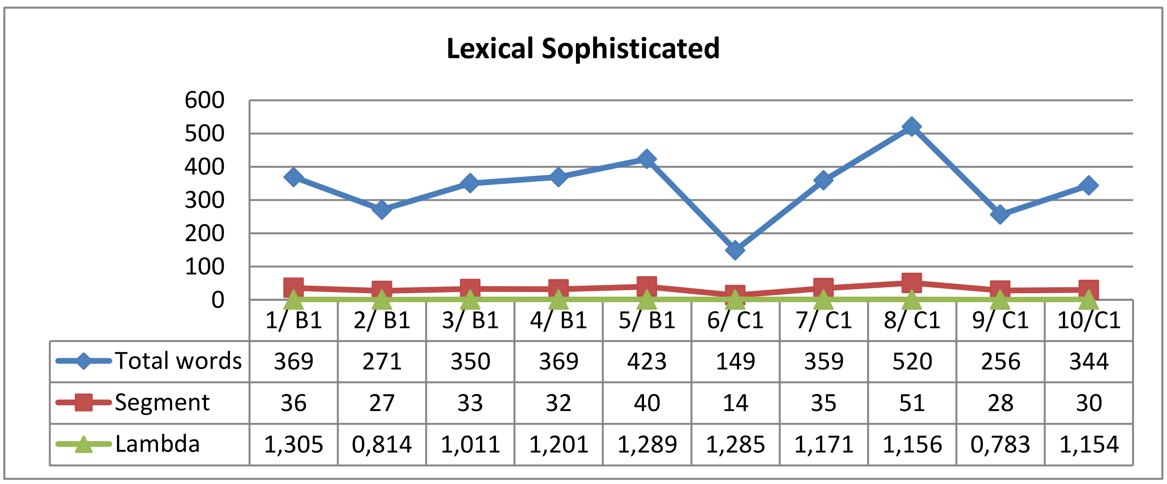
It shows that participants produced words differently and effected the result of their Ds. Theoretically, low values of D indicate that the source text contain a lot of repetition and is not lexically rich and conversely. It reveals that participant 8 produced the highest number of words (521) but has less value of D (32.8) than participant 7 D value (40.5) who produced fewer number of words (360). That means that participant 7 has produced words lexically more rich. It also describes that both B1 level participants, even though one of them (1) could produce almost similar number of words with one of level C1 participant (7), have low value of D compare to C1 level participants. However, participant 9/C1, exceptionally, produced the least words and D value. The graph also reveals that participant with lower proficiency level (participant 7) could produce words more diverse than other high proficiency level participants could. Obviously, the graph shows that all participants values of D are less than 50 which the highest value of D theoretically is 120 (the value range is 0 – 120).

Table 2. *P_Lex results*

Participant/ Proficiency	Total words	Segment	Lambda	Error
1/ B1	369	36	1,305	0.02851
2/ B1	271	27	0,814	0.05818

3/ B1	350	33	1,011	0.0311
4/ B1	369	32	1,201	0.0272
5/ B1	423	40	1,289	0,0256
3/ C1	149	14	1,285	0.0357
4/ C1	359	35	1,171	0.03490
5/ C1	520	51	1,156	0,04697
9/ C1	256	28	0,783	0,04214
10/C1	344	30	1,154	0,0325

Figure 2. *Lexical sophisticated of participants*



The results of P_Lex analyses show the lexical sophistication of each participant. Lexical sophistication is defined as the percentage of sophisticated or advanced words in a text; although different definitions of sophisticated/advanced vocabulary. Low-frequency words, for instance, are generally considered to be advanced and sophisticated (Laufer & Nation, 1995). P_Lex is based on the idea that it might be possible to make a virtue out of the fact that 'difficult' words occur only infrequently in texts. P_Lex looks at the distribution of difficult words in a text, and returns a simple index that tells us how likely the occurrence of these words is. The underlying assumption here is that people with big vocabularies are more likely to use in frequent words than people with smaller vocabularies are, and that we can use the index we derive from the texts as a pointer to vocabulary size.

The graph above reveals that participant 1(B1 level) could produce the highest number sophisticated words among all participants although she/he produced less words than participant 8 (C1 level). It follows by participant 5 (B1level) who produced higher number of words (423). From the graph, it also describe that participants proficiency level do not have positive correlation with their word sophistication (advance words knowledge). It could be seen that participants has produced few segments of words (few than 100). They produced low number of sophistication value (lambda) that is described clearly from the line graph.

Conclusion and Pedagogical Implication

The findings of this study can be a useful reference in the field of language pedagogy. Such findings can be used by language teachers and administrators in a pedagogical context to make decisions concerning utilizing adequate tools in investigating whether or not learners have enough lexical resources necessary to function effectively in the foreign or second language. This also may help teachers to reflect on their teaching and the suitability of their teaching materials. Lexical richness should be a relevant factor to be taken into consideration in material design and learner assessment. This study shows that both of D_tools and P_Lex obtain a reliable measurement of lexical diversity and lexical sophistication, which is stable across. It also demonstrates that researchers can clearly discriminate between learners of different proficiency levels. From the results presented above, it can be concluded that as foreign language learners, lower level of proficiency participant could produce more lexically rich text than higher level participant and vice versa. Yet, this study should be improved for the future investigation although the assessment software used in this research present a reliable number of results to significantly correlate the level ‘of participants language proficiency with their lexical diversity and sophistication.

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