

Utilizing an Automated Tool Analysis to Evaluate EFL Students' Writing Performance

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Abstract

Recently, the integration of linguistics and technology has been promoted and widely used in the field of linguistics and English writing for several purposes. One of those purposes is to evaluate EFL writing ability by using electronic assessment tools in language teaching or rhetorical studies.

In this study, an automated writing evaluation tool (Coh-Metrix version 3.0) was used to indicate English-major students' writing performance based on the six discourse components of the texts and to determine the associations between those six results of Coh-Metrix analyses. The 80 EFL texts produced for each scheme of writing tasks on two different topics were collected. The corpus analyses gathered from Coh-Metrix identify linguistic and discourse features that were interpreted to determine the 40 EFL undergraduate students' English writing abilities. The students wrote and revised their essays in a hand written form in class and resubmitted their essays in digital forms with corrections made. The results showed that these writers demonstrated linguistic flexibility across writing prompts that they produced. The analyses also indicated that the length of the texts, the word concreteness and the uses of the referential and deep cohesion had impacts on the students' writing performances across the writing tasks. Besides, the findings suggest practical value in using the Coh-Metrix to support teachers' instructional decisions that could help to identify improvement of students' writing skill.

1. Introduction

Recently, the uses and effects of automated tools in analyzing students' writing have been of interest (Haswell, 2000; Allen et al., 2018). Advances in computational linguistics and discourse processing have shown possibilities that educators or researchers can automate many language- and text-processing mechanisms. For example, an automated text tool can provide information about multiple variables in textual features (Elfenbein, 2011), explain differential findings of multilingual texts, allow users to easily store results of analyses in data files, and demonstrate cohesion relations and language discourse characteristics.

Computerization is considered reliable in managing basic to complicated discourse components in linguistics, such as accessing vocabulary from online dictionaries and indicating misspelled words, basic morphemes, or phonemes. Through advances across disciplines has made it possible to conduct computational assessment of language and text comprehension that exceed those basic linguistic elements. The disciplines that advance the field of linguistic study include computational linguistics (Nesi and Gardner, 2012; Allen et al., 2018), analyses of structural and mechanical errors in texts (Crossley, Bradfield & Bustamante, 2019), and discourse processing (Sarawit, 2013; McNamara et al., 2014; Hardy and Friginal, 2016; Sulaiman and Wilson, 2018). Scientific research and language technologies have then been integrated, so linguists or educators can benefit from the automated text analyses. One such level of language analysis that demonstrates a particular computational challenge is the discourse components of the students' texts (McNamara et al., 2014).

In the present study, a computational linguistic tool (Coh-Metrix) was employed to systematically analyze students' texts in an undergraduate English writing course. Specifically, the discourse components (number of words, narrativity, syntactic simplicity, word concreteness, referential cohesion, and deep cohesion) of the students' texts on the task 1 and 2 writings were compared to investigate the students' L2 writing performances. The descriptions of Coh-Metrix and research related to its implications are discussed in the following sections.

1.1 Brief overview of Coh-Metrix

A variety of available Natural Language Processing (NLP) tools have been introduced and used to demonstrate how these tools evaluate and analyze language discourse of texts (McNamara et al., 2014; Sulaiman and Wilson, 2018). Coh-Metrix is one of those tools that has been widely used in L2 writing studies concentrating on writing development, a prediction of quality of essays, an analysis of differences between L1 and L2 compositions, and an effect of writing tasks (Crossley et al, 2013; Roscoe et al., 2016). As it is aligned within a variety of theoretical framework, Coh-Metrix has been utilized to automatically calculate specific linguistic information ranging from basic text features to higher levels of measurement. Coh-Metrix is available for free download on the website (<http://www.cohmetrix.com>).

Coh-Metrix reports statistical information including the length of specific discourse units within the text meaning that a report of the analysis will show the number of words and paragraphs, the average length of words, and the number of sentences. At a more shallow level of analysis, it is used to calculate the types of words containing within a text like the levels of word specificity, the average frequency of individual words, and the diversity of words found in the text. Coh-Metrix is useful for measuring syntactic complexity; however, it cannot make much sense of larger discourse units such as phases of text. Generally, Coh-Metrix yields the results of analyses on the six levels in the multi-level theoretical framework as follows:

Table 1

The six discourse components in the multi-level theoretical framework in the present study

Coh-Metrix Variable	Description
Word length	The total number of words found in the text is calculated using the output from the Charniak parser that generates a parse tree with part of speech tags for clauses, phrases, words or punctuations.
Narrativity	The text tells a story with characters, events, places, and things that are familiar to a reader. Stories are basically about everyday oral conversation.
Syntactic simplicity	This component shows the degree to which the sentences in the text contain fewer or more words with the uses of simple, familiar or complex, unfamiliar syntactic structures.
Word concreteness	Content words are concrete and meaningful that are simpler to understand. While, abstract words are difficult to represent visually, so the texts that have a lot of abstract words tend to be more challenging than those content words.
Referential cohesion	Higher referential cohesion tends to have words and ideas that extend beyond sentences and the entire text. Lower cohesion is typically more difficult to process or connect the ideas together.
Deep cohesion	This reflects the degree to which the text contains causal and intentional connectives that help the reader to have a more coherent and deeper understanding of events, processes, or actions in the text.
<i>Note:</i> The description of this framework is adapted from the website (http://141.225.41.245/cohmetrixhome/documentation_indices.html).	

1.2 Coh-Metrix in writing research

Some researchers have implemented the Coh-Metrix to measure multiple levels of language and discourse such as a textbase, a situation model, and a rhetorical structure. Following the uses of automated text evaluation, researchers have undertaken further investigations of quality of texts in different EFL writing environments.

One such effort that has brought to the attention of researchers in writing is a study carried out by Graesser et al. (2014). They reviewed how the five factors (narrativity, syntactic simplicity, word concreteness, referential cohesion, and deep cohesion) account for text variations. Snow et al. (2015) examined how students varied in their uses of linguistic features across writing prompts by utilizing the Coh-Metrix to evaluate the linguistic features of students' essays and whether those features were associated. According to Snow et al.'s study, forty-five students wrote essays across eight sessions. The results revealed that students' narrative flexibility scores were positively related to their background knowledge and prior writing ability. Among others, Aryadoust and Liu (2015) used the Coh-Metrix to measure a theoretical model by investigating the associations between the linguistic features of text complexity and text quality. In their study, Chinese EFL learners wrote expository and persuasive essays. The differences and similarities in the two sets of linguistic features were investigated. The linguistic

features including lexical sophistication, syntactic complexity, cohesion, and basic text information were identified to see an association with the writing scores for both integrated and independent sampled groups. The findings showed that lexical sophistication was a predictor for writing assignments. Besides, syntactic features such as verbs in third-person-singular form and semantic similarity were significantly found as predictors for the integrated writing assignment.

In response to the literature, the present study examined the discourse components of the EFL students' texts based on the five components: *syntactic simplicity*, *word concreteness*, *referential cohesion*, *deep cohesion*, and *number of words* in the students' texts to characterize each of these discourse components and to determine the writing proficiency of their writings. The research questions are as follows:

- 1) Based on the results of the discourse components of the texts analyzed by the Coh- Metrix, what are the characteristics of the students' writings performances?
- 2) Is there any significant correlation among those discourse components of the texts from task 1 and task 2?

2. Method

2.1 Participants

The 40 participants had been purposively selected from the 80 students in English major from a large university in Thailand who voluntarily attended in the present study. The selection of the participants in the present study was based on the scores from their task 1 and task 2 writings. Each text had been rated holistically on a four-point scale. Out of 160 texts (80 writers X 2 texts), the researcher chose 40 texts given lowest scores by the two raters and the other 40 texts given highest scores. The researcher analyzed these selected 80 texts according to the linguistic and discourse features as well as determining the associations between those results of Coh-Metrix analyses. Prior to participating in the current study, the students had taken writing classes as the prerequisite courses for their degrees, so they had background knowledge of diverse genres of writings.

2.2 Study Procedure

During the course of the study, the participants were assigned to write essays in a four-week interval on two different topics over the 8 week period. For the purposes of the study, only two writing tasks (one at the beginning and the last one at the end of the study) were collected to determine their writing performance, investigate the characteristics of the students' texts, and find out associations between the dimensions of the students' writing performances. In doing so, the participants wrote on a total set of two argumentative essay topics: 1) *Is education useless in the 21st century?* and 2) *A Week Without Access to the Internet*. In doing so, the students wrote each essay in a 50 minute session and submitted their essays in a digital form as Coh-Metrix only examined the edited digital form of the texts. The researcher had informed the participants that their scores from both tasks would not affect their grades; therefore,

they were not allowed to use the word processor’s automatic grammar and spell checker for their digital texts. In addition, the participants were asked to submit their hand-written drafts and the digital texts to the researcher so that they could be easily reviewed and compared.

2.3 Texts and Performance Evaluation

The corpus of 80 texts (40 writers x 2 texts) was measured on their ease/difficulty with respect to particular components of discourse. More specifically, the Coh-Metrix computed a normalized z-score on each of the five components.

3. Findings And Discussion

As previously stated, the texts were analyzed for *the number of words* and the five discourse components of the students’ texts: *narrativity, syntactic simplicity, word concreteness, referential cohesion, and deep cohesion* using the Coh-Metrix version 3.0 in response to a research question. The descriptive statistics of the number of words in the task 1 and 2 writings and the z-scores on the other five discourse components are presented in Tables 2 and 3 respectively.

3.1 Number of words

By indicating the results of the text analyses, the number of words in the 80 texts is shown in Table 2.

Table 2
The descriptive statistics of the number of words in texts

	<i>n</i>	Minimum words	Maximum words	<i>M</i>	<i>SD</i>
Word count on task 1	40	271.00	895.00	511.86	173.00
Word count on task 2	40	296.00	1121.00	575.97	200.63

The essays averaged 511 words on task 1 and 575 words in length on task 2 writing. By comparing the number of words between the writing tasks, it was found that 29 participants (69%) wrote longer texts on the task 2. Statistically, the number of words from task 1 and 2 writings were found significantly higher in length, $t(41) = -8.57, p < .05$. Likewise, a finding from Sarawit’s study (2013) demonstrated a significant increase in the number of words per paragraph. Together, this suggests that successful writers tend to produce linguistically longer texts (Applebee et al., 1990; Crossley & McNamara, 2011; McNamara et al., 2013; Crossley, et al., 2014) with fewer errors in spelling, grammar, or punctuation.

Research question 1: *Based on the results of the discourse components of the texts analyzed by the Coh-Metrix, what are the characteristics of the students’ writings performances?*

3.2 Overall writing performance

The Coh-Metrix reported z-scores of each writing component to evaluate the students' writing abilities in the present study. Statistically, a z-score is a standardized metric in standard deviation units, with the value of zero being the mean and higher scores being easier for a particular component. The z-scores are higher and positive when the texts are easier on the component and more negative when the texts are more difficult (Dede & Richards, 2012).

In Table 3, the z-score ranges for levels of language and discourse.

Table 3
Z-score ranges for each discourse feature

Z-score range	NT1 (n=40)	NT2 (n=40)	SS1 (n=40)	SS2 (n=40)	WC1 (n=40)	WC2 (n=40)	RC1 (n=40)	RC2 (n=40)	DC1 (n=40)	DC2 (n=40)
-2.5 to <-2.0	-	-	-	-	-	2	-	-	-	-
-2.0 to <-1.5	-	-	-	-	2	6	-	-	-	-
-1.5 to <-1.0	-	-	2	1	6	19	3	-	-	-
-1.0 to <-0.5	3	1	5	8	17	7	10	3	-	-
-0.5 to <0.0	12	16	14	13	13	6	11	15	-	-
0.0 to <0.5	18	13	15	10	2	-	7	11	3	-
0.5 to <1.0	6	7	4	8	-	-	7	3	6	2
1.0 to <1.5	-	2	-	-	-	-	1	6	7	7
1.5 to <2.0	1	1	-	-	-	-	-	1	11	11
2.0 to <2.5	-	-	-	-	-	-	-	1	7	11
2.5 to <3.0	-	-	-	-	-	-	-	-	2	4
3.0 to <3.5	-	-	-	-	-	-	-	-	2	3
3.5 to <4.0	-	-	-	-	-	-	1	-	2	2
<i>Note:</i> NT = Narrativity; SS = Syntactic Simplicity; WC = Word Concreteness; RC = Referential Cohesion; DC = Deep Cohesion										

Overall, approximately 80% of z-scores of the 80 texts were less than or equal to the mean z-score (0.0) and continued to become smaller across almost discourse components meaning that a large proportion of the texts were at the level of satisfactory based on the PT criteria, except for the deep cohesion. Besides, the proportion of the smaller and negative z-score ranges in the word concreteness reflect a much larger improvement, particularly for the task 2.

For the deep cohesion, more than 90% of all texts were larger than the mean z-score and continued to increase. As this happened, the texts were considered at the unsatisfactory or the questionable level presuming that the writers tend to use less cohesion in their texts.

3.3 The characteristics of the students' texts on the five discourse components of texts

Besides the statistical data reported above, the researcher has undertaken further investigation of the major discourse components of the students' texts. The example extracts and paragraphs below characterized students' rhetorical writing performance.

3.3.1 Narrativity

In Table 3, the results were chosen to give the overall view of the typical z-scores for each writing component in the present study. Highly narrative texts are typically easier to read (Allen, Likens & McNamara, 2018).

For the narrativity, approximately 75% of the z-scores were at the mean (0.0) or less than -0.5 meaning that the students conveyed their story telling in a more complicated way and rather difficult to read on both the task 1 and 2. The results of the z-score report also reflects the degree to which a story is being told, using characters, places, events, and other things familiar to readers. The example paragraphs below show the different characteristics of the texts through the uses of verbs, intentional actions, and the frequent pronouns that the writers used to convey the messages to their readers. For example:

(1) I *use* YouTube to *listen* to music, *watch* movies, and something which *makes* me fun. Accordingly, access to the Internet *makes* me *feel* so relaxed after having studied so hard.

The paragraph (1) from the task 2 illustrates the uses of *verbs* and *intentional actions* in writer's anticipated experiences of a week without an access to the Internet. The writer used the verbs like *use*, *listen*, *watch*, *makes*, and *feel* to visualize the actions that he/she routinely does in everyday life.

Overall, the analysis shows that the writers could employ high frequent words and simple syntax in their writings. The following paragraph from the task 1 illustrates these characteristics.

(2) Internet is one of the important things to me. *I* spend my time with *it* about ten hours per day. *I* like to watch the movies or drama series, *listen* to music, and read some articles in Facebook. Furthermore, *I* often use *it* to communicate with my friends. Nevertheless, *I* cannot connect the internet when *I* come back home.

This paragraph (2) has a fairly strong beginning as it states how the Internet is important in the writer's life by giving examples in the second and the third sentences. Notice that the writer repeated the pronoun "*I*" several times in almost all the sentences illustrating that the writer strongly emphasizes personal

experiences relevant to the topic. This first-person pronoun was mostly found in the low-rated essays. This might be that a less skilled writer's attempts to begin writing a sentence and to avoid errors such as third-person pronouns or other ambiguous pronouns. This is advocated by Author's (2013) study found a high frequency of first-person pronoun like 'I' and showed an increase in the uses of first person pronouns or self-referential pronouns in L2 essays which demonstrated L2 writers' lower proficiency. Likewise, Leki, Cumming, and Silva (2010) stated that the pronoun 'I' was one of those first person pronouns that refers to the writer and it was most common making up to 60 percent of total self-referential pronouns found in L2 writings.

3.3.2 Syntactic simplicity

Over 70% ($n = 29$) of z-scores on the task 1 were equal to or less than the mean value showing that the students were able to write the sentences containing more words and complex syntactic structures than those on the task 2 (57%, $n = 23$). The researcher investigated in depth found that the texts on the writing task 2 had fewer words and even used simpler syntactic structures. The following two different paragraphs were written by the same student showing the differences of the syntactic structures between those two writing tasks. The first paragraph was on the topic of "*Is education useless in the 21st century?*"

(3) First of all, learning from schools is really important for children. Schools help their parents for take care of them while they are working. Children can play and meet their friends. It makes them learning each other and learning to handle with people.

With regard to syntax, the writer of the paragraph (3) tends to write choppy sentences resulting the writing unsophisticated and disconnected. The simple structures of syntactic structures apparently demonstrate the ability of the writer as he/she frequently employed simple sentences. In addition, a larger proportion of the frequent words like *is*, *are*, and *can* strongly suggests that considerably less new information is contributed in the text. This is suggested that the uses of transitional words such as *moreover*, *furthermore*, *then* or coordinating conjunctions like *and*, *but*, and *so* might supply the transitional words and/or the cohesive ties across a paragraph resulting the links of the ideas and the expression of the new descriptions to the texts.

Compare the previous example paragraph (3) with the following paragraph from the same writer who wrote the second text on the topic of "*A week without access to the Internet.*"

(4) Firstly, Thai students lack of taking their responsibility. In the morning, some students are like to attend the class lately. *Moreover*, they do not realize it will be the reason to lead them to become lazy person.

Furthermore, some of them are likely to procrastinate on their task or duty. They might look like lazy person. But learning online must take a lot of responsibility on them *because* no one can force or

motivate you to do it like learning in class. *Then* this is the reason *that* Thai students are not ready for learning online.

The following paragraph (4) shows the uses of *because* and *that* illustrating a more elaborated text with more complex syntactic structures. This writer also produced a longer text with less choppy sentences. Besides, the writer employed transitional words (e.g. moreover, furthermore, then) more often to describe the associations between the ideas in the paragraph.

3.3.3 Word concreteness

To explore the word use in the texts, the Coh-Metrix was employed to analyze the content words that are concrete and evoke visual images that readers are easy to recognize and understand. The results of the analysis show that z-scores of the task 2 writing were less than -1.0 meaning that overall the writers tend to use more content words in the task 2 ($n=32$, 80%) and the texts contain more abstract words that are more complicated to comprehend than those in the task 1 ($n = 30$, 75%) that the writers tend to use words that convey visual images rather than those that represent abstract concepts.

The following texts are written by the same writer. The following paragraphs illustrate these characteristics:

(5) Basically, education makes life better. *Educated* people are different from uneducated one in many way, such as *attitude*, *lifestyle*, and *social status*. Even at the present time, there are many jobs that everybody can do without knowledge, but those jobs are not good enough to *make a living* and to *be accepted* by society.

By contributing importantly to greater uses of abstract ideas, the writer of the text (5) on the task 2 seems to have in part the abilities to perceive abstract concepts with reference to particular instances (e.g., *educated*, *attitude*, *lifestyle*, and *social status*) and verbs (e.g. *make a living*, *be accepted*) to distinguish relationships among ideas and to express the writer's experience into the text. This is associated with the writer's schemas of prior knowledge which he/she shared with readers and could draw on to express himself or herself efficiently and effectively (Hyland, 2018). It can be assumed that the students showed an ability to adapt their writing to the requirements of the task at hand, thus displaying an awareness of linguistic repertoires beyond that of just task 1.

Comparing the paragraphs (5) and (6) written by the same writer, the paragraph (6) contains a fewer number of the abstract words for his/her second writing.

(6) Another important reason that *make* Thai students are not ready to *learn* English online is they might not *understand* what they are *learning* because they do not *have* a right direction.

The paragraph (6) tends to be densely written with a larger number of action verbs (e.g. *make*, *learn*, *understand*, and *have*) to describe the actions the subject might do in each situation. A recent study

(Hyland, 2018) also found that their participants often used action verbs to bring their stories alive.

3.3.4 Referential cohesion

The linguistic features and the discourse components of the texts were predictive of the participants' writing performances on the task 1 and the task 2 writings. As can be seen from the results, a large proportion of the z-scores on the referential cohesion at the mean or less than -1.0 of the task 1 and 2 texts were about half of all texts.

To characterize overall texts, it was found that the students tend to reiterate what is said in the previous sentences with the same words or pronouns. The following example paragraph illustrates this characteristic:

(7) For a decade that the internet has become accessible in Thailand. It makes *people's* life more convenient. For example, *people* do not have to go to the library when *they* need to find some information, or *they* can learn new lessons through online courses when *they* do not want to leave home.

Regarding the referential cohesion item, '*they*' was repeated three times. The last one of them in the extract "...when *they* do not want to leave home" shows the redundancy in the paragraph seems to be a flaw because the writer failed to provide the noun *they* referred to as it was expected to appear.

Consider again by comparing the previous example paragraph with the following extract from the task 2 written by the same student.

(8) As a result, *Thai students* do not gain adequate learning. For example, English is not our mother tongue language; therefore, *the students* cannot question about unknown knowledge when *they* do not comprehend *their* lesson.

Notice that in this paragraph (8), it extends the semantic domain of the concept of *Thai student* to include different lexical items like *the students* and *they* respectively.

In sum, the findings show that the participants may need to use less frequent words or repeated words but a larger number of lexical items to elaborate their writings and explicitly

express ideas and give new information to their readers. This is to suggest that uses of referential cohesion will reflect the degree to which words and ideas go beyond a text. Consequently, texts that contain relatively high referential cohesion will represent associations between ideas and that are feasible to read (Allen, Likens, & McNamara, 2018).

3.3.5 Deep cohesion

In the analysis of deep cohesion, it was concerned with the degree to which the texts contain causal and intentional connectives in the sentences including *causal* (because, so), *additive* (and, moreover), *temporal* (first, until), *logical* (and, or), and *contrastive* connectives (although, whereas) that help readers to form a more coherent and deeper understanding of the causal events, processes, and actions in the texts.

The results of the analyses show that a major range of the z-scores of the task 1 and 2 was 1.0-2.5, which is 62% ($n = 25$) and 72% ($n = 29$) respectively. The interpretation of the results depends upon presupposed information contained in the PT criteria. The PT criteria suggest that a higher degree of z-scores is at the questionable or unsatisfactory level, so these high z-scores determine a fewer degree of deep cohesion on both tasks leading to the ambiguous texts.

(9) Firstly, education is essential as of the world today. In the present, the world is moving fast and keep on going. Technologies have developed *and* are more advanced as time passes. New inventions are being discovered rapidly. *Therefore*, it is important to keep the knowledge up to the standards of those new innovations.

The paragraph (9) illustrates that the writer attempted to use coordinating conjunction '*and*' to connect the two different verbs in the present perfect and past participle forms as well as the use of conjunctive adverb '*therefore*' to make a sequence of sentences. Though conjunction creates cohesion in the paragraph and provides extending and enhancing paragraph, the writer used a few conjunction types in his or her text. As a result, the writer contributed less elaboration in his or her writing. The majority of the texts exhibits a few number of cohesive ties like coordinating conjunctions like *and*, *but*, and *so*, conjunctive adverbs like *still* and *even though* that supply cohesive ties across sentence boundaries. The z-scores reflect a fewer number of cohesive ties found in the overall texts causing relatively low in the associations of the lexical and grammatical structures and the less sentence sequences to be understood as connected discourse (Halliday & Hasan, 1976). Compared to Halliday and Hasan's cohesion, Coh-Metrix does not measure ellipses or substitution. Besides, Coh-Metrix does not account for paraphrased elements and semantic inferences, thematic patterning, nor can it track participants across phases of discourse or the clauses.

The analyses provide evidence for the fact that the writers demonstrated linguistic flexibility across the essays that they produced. A majority of the writers wrote longer texts on the task 2 writing compared with those shorter texts on the task 1 writing. A fewer uses of cohesive ties to bind the sentences together cause the unelaborated sentences. In regard to those five discourse components of the texts, the results show that the students' writing performance on the task 1 and the task 2 writing were at the level of satisfactory, except for the deep cohesion on both tasks 1 and 2 that over 60 percent of the students performed at the level of questionable or unsatisfactory.

The following section demonstrates a further analysis on correlations between the discourse components of the texts that were also investigated and answered to a research question.

3.4 Multiple-variable correlations

Research question 2: Is there any significant correlation among those discourse components of the texts?

The data from the 80 texts were examined to indicate the relationships between the results from the corpus analyses by using the Pearson correlations.

Table 4
Correlations among the variables

Variable	1	2	3	4	5	6	7	8	9	10
1. Nar1	-									
2. Nar2	.227	-								
3. Syn1	-.262	-.111	-							
4. Syn2	-.156	.029	.614**	-						
5. WC1	-.132	.145	-.144	.066	-					
6. WC2	-.004	-.469**	.033	.087	.127	-				
7. RC1	.656**	.274	-.511**	-.167	.005	-.102	-			
8. RC2	.176	.482**	-.411**	-.397**	.160	-.209	.444**	-		
9. DC1	.099	-.020	.148	-.105	.114	-.023	-.159	-.006	-	
10. DC2	-.006	.472**	.144	.091	.267	-.286	.032	.300	.076	-
Note. 1 = task 1 writing; 2 = task 2 writing; Nar = Narrativity; Syn = Syntactic Simplicity;										
WC = Word Concreteness; RC = Referential Cohesion; DC = Deep Cohesion; WS = Writing Score; WCo = Word Count										
** Correlation is significant at the .01 level (2-tailed)										
* Correlation is significant at the .05 level (2-tailed).										

The results in Table 4 show the correlations between the z-scores of the students' writing components. These results indicated that the z-scores of the referential cohesion were found associated with syntactic simplicity on the task 1 ($r = -.41, p = .00$), and on the task 2 ($r = -.39, p = .00$) respectively. One possible reason for the associations between the referential cohesion and complex syntactic sentences could be that more proficient writers tend to use deliberately syntactic writing by using cohesion to associate the lexicon with the grammar found in the texts. In doing so, sentence sequences were understood as connected discourse of the texts (Halliday & Hasan, 1976).

Among the variables on task 2 writing, the z-scores of the narrativity were found significantly related to word concreteness ($r = -.46, p = .00$), referential cohesion ($r = .48, p = .00$), and deep cohesion ($r = .47, p = .00$). These relative associations give another indication that the writers were able to tell their stories, expand and connect their ideas through the concrete words and cohesion. Regarding words in texts, more-skilled writers tend to have a greater number of working words to develop their writings, thereby expressing their ability to use sophisticated language and more diversity of words in their writings (Crossley, Kyle, McNamara, 2016; Author, 2018).

The z-scores of syntactic simplicity on the task 1 and 2 were significantly related ($r = .61, p = .00$). The results interact to a great degree as syntactic sentences and a shorter length of texts can predict the quality of the texts (Polio & Shea, 2014; Bulté, & Housen, 2014; Author, 2018).

All this is to suggest that the degrees of associations of the z-scores of discourse components of the texts are different. The students' EFL writing performance of using English vocabulary, being capable of extending their concepts and expressing their complexity of English language are related. As a result, the writers tend to develop more ideas around the writing topic as well as employ more sophisticated words in their texts. As reported in the earlier section, a few number of the referential cohesion and the deep cohesion uses interchangeably decreased across the two writing tasks, so their z-scores were found associated.

4. Conclusion And Implications

The findings of this study support the notion that the linguistic properties and the discourse components of texts are generally associated. In this study, the researcher empirically examined the research assumptions by using a computational linguistic tool to analyze EFL students' texts. The analysis focused on both natural language processing to capture the writing abilities and calculating specific linguistic information ranging from basic text features to higher levels of measurement.

An examination of the discourse components of the texts shows relationships between the variables. The results from this study may yield vital information for writing researchers and educators. As it has been claimed in several studies, the discourse components cannot be isolated to indicate students' writing performance or proficiency. The links between linguistic properties and writing process could be significant predictors of the students' writing performance.

Future research in the realm of EFL writing may be integrated into a number of rhetorical settings and the uses of automated English writing tools to better evaluate and improve students' writing skills. In practice, writing teachers may implement the Coh-Metrix in their classes to evaluate and analyze the discourse components of texts yielding feedback from teachers' instruction as well as demonstrating students' learning progress. Besides, future research may include a figure that gives an indication of how many errors, on average, will be presented in students' texts. Limitations of this study were the small number of participants. In order for researchers in the writing field to analyze larger samples and be able to

generalize in ways that the researcher could not, better methods of recording revision changes may also need to be explored.

Declarations

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Availability of data and materials

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Competing interests

The author declares that she has no competing interests.

Authors' contributions

This study was conducted by a single author, and the only contributor is the author herself. The author read and approved the final manuscript.

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Figures

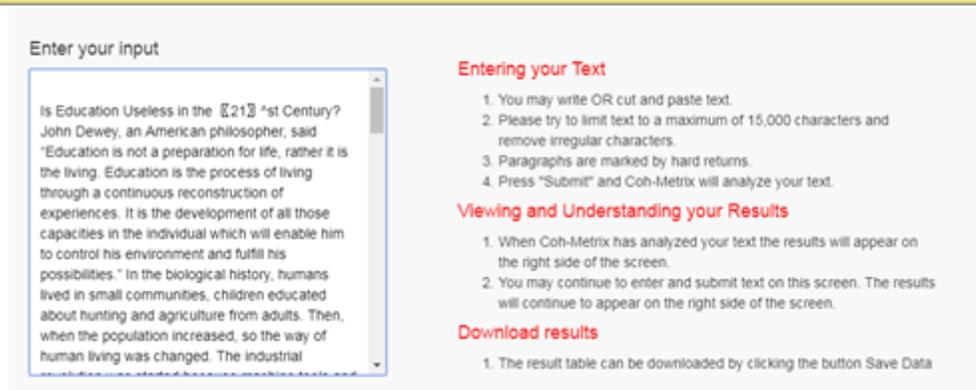


Figure 1

Screenshot of the Coh-Metrix version 3.0

Number	Label	Label V2.x	Text	Text2	Text3	Text4	Text5	Text6	Text7	Full description
1	DESPC	READNP	3	4	3	1	5	5	3	Paragraph count, number of paragraphs
2	DESSC	READNS	20	19	29	12	29	23	18	Sentence count, number of sentences
3	DESWC	READNW	319	334	552	253	375	391	329	Word count, number of words
4	DESPL	READAPL	6.667	4.75	9.667	12	5.800	4.600	6	Paragraph length, number of sentences in a paragraph, mean
5	DESPLd	n/a	3.786	1.258	8.963	0	2.775	1.673	5.292	Paragraph length, number of sentences in a paragraph, standard deviation
6	DESSL	READASL	15.950	17.579	19.034	21.083	12.931	17	18.278	Sentence length, number of words, mean
7	DESSLd	n/a	8.338	10.238	7.169	6.543	5.411	7.954	7.858	Sentence length, number of words, standard deviation
8	DESWLsy	READASW	1.542	1.638	1.393	1.407	1.477	1.535	1.398	Word length, number of syllables, mean
9	DESWLsyd	n/a	0.885	1.003	0.700	0.764	0.777	0.870	0.687	Word length, number of syllables, standard deviation
10	DESWLit	n/a	4.483	4.757	4.141	3.992	4.515	4.537	4.176	Word length, number of letters, mean
11	DESWLitd	n/a	2.682	2.712	2.289	2.234	2.173	2.570	2.211	Word length, number of letters, standard deviation
12	PCNARz	n/a	1.177	-0.094	1.779	2.327	0.529	0.892	1.191	Text Easability PC Narrativity, z score
13	PCNARp	n/a	87.900	46.410	96.160	98.980	69.850	81.330	88.300	Text Easability PC Narrativity, percentile
14	PCSYNz	n/a	0.022	-0.097	-0.327	-0.576	0.838	0.405	-0.681	Text Easability PC Syntactic simplicity, z score
15	PCSYNp	n/a	50.800	46.410	37.450	28.430	79.670	65.540	24.830	Text Easability PC Syntactic simplicity, percentile
16	PCCNCz	n/a	-0.876	-0.330	-0.738	-0.894	-0.148	-1.551	-0.438	Text Easability PC Word concreteness, z score
17	PCCNCp	n/a	19.220	37.070	23.270	18.670	44.430	6.060	33.360	Text Easability PC Word concreteness, percentile
18	PCREFz	n/a	0.273	0.175	0.990	1.702	0.104	-1.014	0.562	Text Easability PC Referential cohesion, z score
19	PCREFp	n/a	60.640	56.75	83.650	95.540	53.980	15.620	71.230	Text Easability PC Referential cohesion, percentile
20	PCDCz	n/a	2.108	1.409	1.952	2.016	1.867	0.817	2.277	Text Easability PC Deep cohesion, z score
21	PCDCp	n/a	98.210	91.920	97.440	97.780	96.860	79.100	98.840	Text Easability PC Deep cohesion, percentile
22	PCVERBz	n/a	0.472	1.335	-0.495	0.815	1.806	-0.313	1.217	Text Easability PC Verb cohesion, z score

Figure 2

Screenshot of the Coh-Metrix output