

APPLICATION OF COH-METRIX TO DETERMINE THE READABILITY LEVEL OF COMPREHENSION TEXTS A CASE STUDY

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Abstract - This paper discusses how the Coh-Metrix system was used to measure readability levels of comprehension texts used by the teachers of English for classroom instruction at a junior secondary school. The researchers wanted to determine if the comprehension texts match the readability level of students at this level of education. This is important because all the students at the school are not native speakers of English. Therefore, they are learning English as a Second Language (ESL). However, the authors of the majority of the English textbooks used in schools are native speakers of English. The study was qualitative in design and five (5) comprehension passages used by English Language teachers for assessment purposes were selected for this study. The data derived were analysed qualitatively. The results showed that random selection of English Language comprehension texts without subjecting them to a readability test such as the Coh-Metrix may compromise the quality of learning. The results also showed that the readability level of textbooks may contribute to the poor performance of ESL learners and other subject areas.

Index Terms - Coh-Metrix, Readability, Classroom Instruction, English as a Second Language

I. INTRODUCTION

Readability is defined as the “comprehensibility of written text” [1]. Providing students with texts that are matched to reader abilities has always been a challenge for the teachers, educational curriculum developers and other experts in education [2]. A solution to this problem can be the use of readability formulas. In order for educators to identify appropriate texts, measures of text complexity that are validated by research are needed. With the advancement of automated discourse analysis, educators are more technologically advanced and they can write and select texts that are more comprehensible for the (Rachel, 2006). From the 1920s, educators and researchers have discovered a way to use text readability tools to predict the difficulty level of a selected text [4]. The use of Text readability formulas like the Coh-Metrix helps educators to avoid reader-text mismatch. The problem of matching reader ability and text difficulty has been an issue of concern to educationalists. A text readability tool called Coh-Metrix was developed by researchers, Arthur C. Graesser and Danielle McNamara, in 2004. They developed a text readability system that analyzes texts on over 200 measures of cohesion, language, and readability [5]. Coh-Metrix is a computational tool which “analyses texts on multiple measures of language and discourse that are aligned with multilevel theoretical frameworks of comprehension” [6]. Various studies from different researchers, through their in-depth studies have validated Coh-Metrix as a reliable tool [7].

Teachers and other educational experts must assign different texts to students for teaching and learning. The assignment of texts to students is not an easy task. Text readability is an important criterion that guides teachers in the selection of texts and assigning such texts to different groups in class. Readability can be defined as “the ease of understanding or comprehension due to the style of writing.” [8].

On the other hand Richards and others defines readability as “how easily written materials can be read and understood [9]. This depends on several factors including the average length of sentences, the number of new words contained, and the grammatical complexity of the language used in a passage.” Reading comprehension is a process for constructing meaning from text. [10]. Comprehension is an important aspect in creating the foundation of the self-extending system that assists the reader to learn [11].

Research shows that second language (L2) reading process involves the interplay of two language systems. When people read in a second language, they also have access to their first language (L1) and often use their L1 as a reading strategy [10].

II. CONCEPTUAL FRAMEWORK

This study is based on James Cummins’ Threshold theory. The theory has been portrayed as a 3-floor house separated by 2 thresholds or levels (See Figure 1 below).

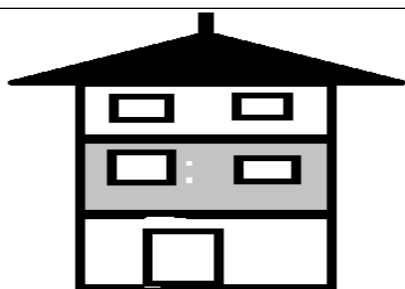


Fig. 1. An illustration of J. Cummins' threshold theory.
Source:Montes, Botero, Pechthalt,

The first floor of the threshold theory: It represents students with below age-level bilingual competence resulting in negative cognitive effects with bilingualism[12]. This is known as either subtractive bilingualism or semi-lingualism. At this stage, the students lack the vocabulary, abstract thinking and other cognitive aspects of the language [13].

The second floor of the threshold theory
At this stage, Cummins suggests that children with age-level proficiency in at least one of the two languages might experience both positive and negative cognitive effects [12]. (Ahearn, Childs-Bowen, Coady et al., 2002), which is what he called dominant bilingualism[13].

The third floor of the threshold theory (the top floor): It symbolizes children with age-level competency or proficiency in both languages enjoying positive cognitive, linguistic and academic advantages in bilingualism [12] referred to as additive bilingualism[13].

The researchers found this theory to be appropriate for this research because it gives the teachers and reading and writing experts to be aware of the different thresholds in language proficiency. The theory stresses the need to explore every possibility to incorporate the different skills which contribute to the reading process when test items are selected for the learners. Some of the skills relate to linguistic features of texts and some relate to the meaning and different levels of understanding.

III. RESEARCH PROBLEM

English as a Second language (ESL) learners are experiencing problems in reading comprehension. Through a Reading and Writing Lab project the researchers have realised that random selection of English Language comprehension texts without subjecting them to readability test such as the Coh-Metrix may compromise the quality of teaching and learning. The researchers embarked on a study to investigate and determine if comprehension texts used by the teachers for item setting for the low performing students suits their reading skills or the expected readability levels of comprehension texts.

IV. RESEARCH QUESTIONS

The study is guided by 2 main research questions:

Does the reading difficulty level of comprehension texts used in junior schools in Botswana match the reading difficulty levels of the low-performing students?

Do teachers consider different reading skills of the students before choosing a comprehension text for item setting?

V. METHODOLOGY

Sample

A total of five (5) reading texts were analysed. The sample texts were entered in the box space provided (see fig.2).

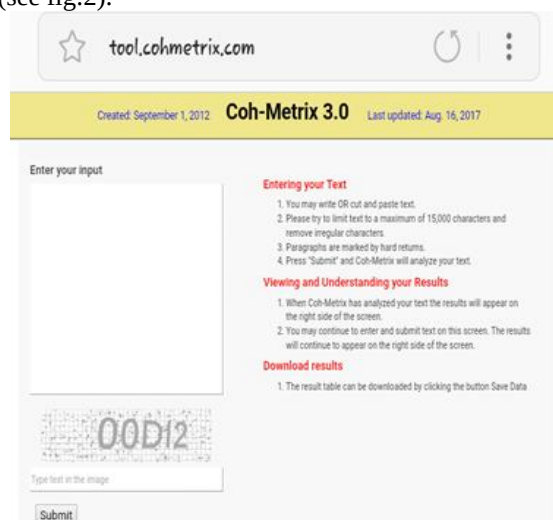


Fig. 2: screenshot of coh-metrix 3.0 showing the textbox where sample texts are inputted

Procedure

The Coh-Metrix 3.0 webtool was accessed at: <http://wwwl.cohmetrix.com/>[14] This is a free web facility (see figure 2)

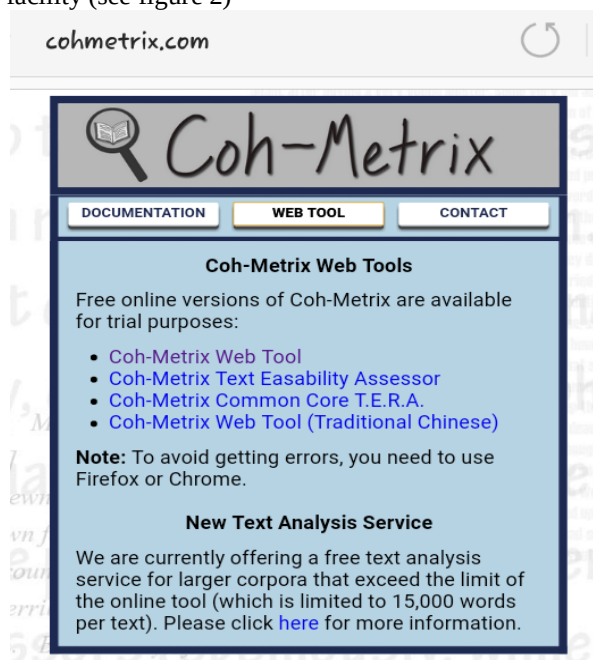


Fig. 3: screenshot of coh-metrix web display.
Accessed at: www.cohmetrix.com

A total of 108 indices are incorporated into Coh-Metrix version 3.0. All the indices were used as qualitative measures for this study. The indices are categorized into eleven groups: (1) Descriptive, (2) Text Easability Principal Component Scores, (3)

Referential Cohesion, (4) LSA, (5) Lexical Diversity, (6) Connectives, (7) Situation Model, (8) Syntactic Complexity, (9) Syntactic Pattern Density, (10) Word Information, and (11) Readability.

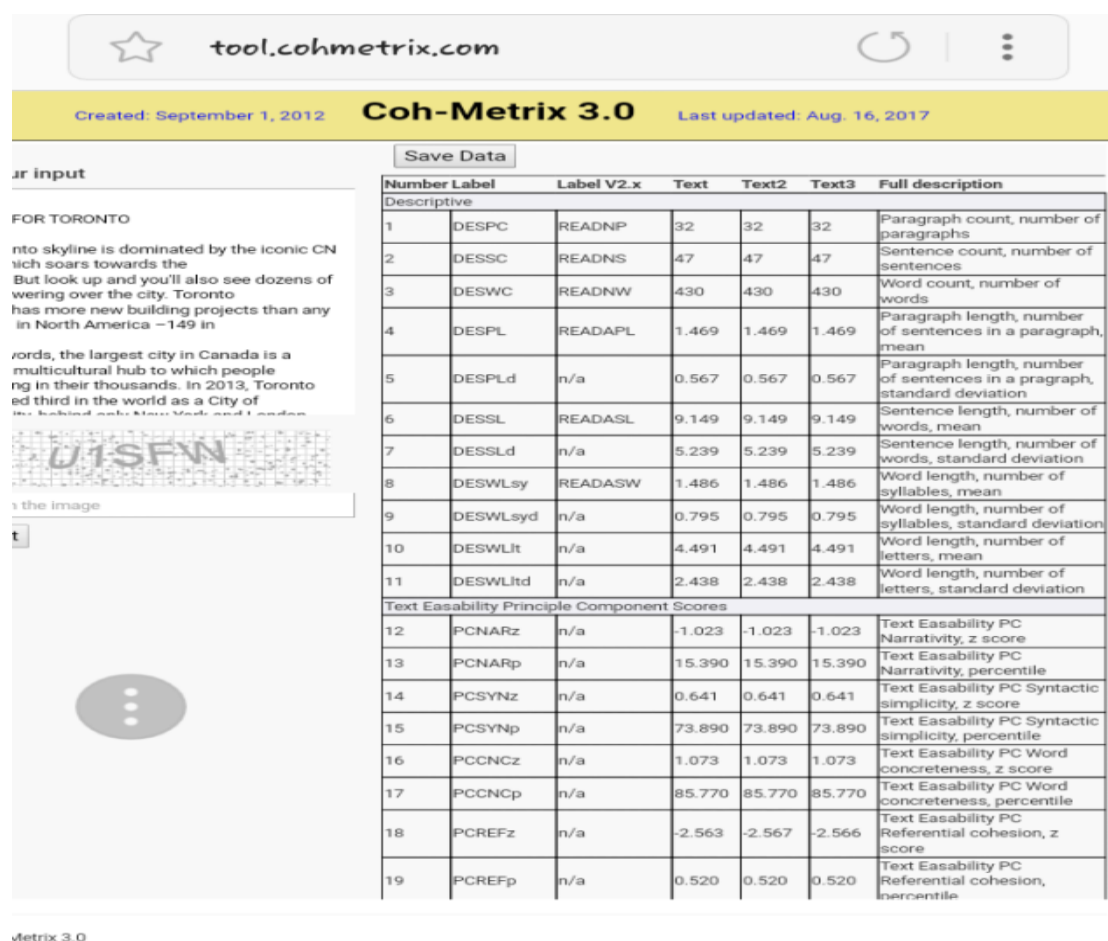


Fig. 3: A screenshot of coh-metrix measures of the different indices on a comprehension text

What do the different indices represent?

Descriptive: Provides basic information about the text you entered to help you check the output and make sure that the information makes sense (e.g., number of paragraphs, sentence count, and word count).

Text Easability Principal Component Scores: Provides scores on the ease or difficulty of the linguistic characteristics of your text (e.g., word concreteness, syntactic simplicity, verb cohesion).

Referential Cohesion: Provides information about the overlap in content words between local sentences or co-references within your text (e.g., noun overlap, argument overlap, content word overlap).

LSA (Latent Semantic Analysis): Provides information about the semantic overlap between the sentences or paragraphs in your text.

Lexical Diversity: Provides information concerning the variety of unique word types that appear in your text in relation to the overall number of words in your text.

Connectives: Provides information concerning the cohesive links between ideas and clauses within your text. **Situation Model:** Provides information regarding the level of mental representation for your text beyond the obvious words, for example, the plot in a narrative.

Syntactic Complexity: Provides information regarding the part-of-speech categories, groups of word phrases, and syntactic structures for sentences (e.g., nouns, verbs, non-phrases, verb-phrases).

Syntactic Pattern Density: Provides information about the concentration of syntactic patterns, word types, and word phrases (e.g., score of noun phrases, score of verb phrases).

Word Information: Provides information on the syntactic categories (e.g., nouns, verbs, adjectives, and adverbs) of the words used and the function (e.g., preposition, pronouns) of the words.

Readability: Provides information on the ease or difficulty in which your text can be read and

understood. [15]. (<http://csal.gsu.edu/content/coh-metrix-advanced-overview>)

RESULTS DISCUSSION

The data were analysed qualitatively and this involved processing text readability measures of the five (5) sample comprehension texts that were randomly selected from a test banks of the English Language teachers. The five comprehension texts were previously used by the teachers of English Language for test item setting. The Flesch Reading Ease score and the Flesch-Kincaid Grade Level were used to measure readability levels of the selected comprehension texts.

How do the tests work?

The Flesch Reading Ease score relies on sentence length and the length of the words within the sentence. Short sentences and small words receive a higher score, while long sentences with longer words receive lower scores.

Formula for calculating reading ease score is as follows:

Flesch Reading Ease = $206.835 - (1.015 \times \text{Average Sentence Length}) - (84.6 \times \text{Average Syllables per Word})$

Average sentence length can be calculated by dividing the number of words by the number of sentences.

The **average number of syllables per word** = number of syllables divided by the number of words.

The Flesch-Kincaid Grade Level

It is an approach used to assess the grade-level of the reader.

Formula for calculating Flesch-Kincaid Grade Levelscore is as follows:

Step 1: Calculate the average number of words used per sentence.

Step 2: Calculate the average number of syllables per word.

Step 3: Multiply the average number of words by 0.39 and add it to the average number of syllables per

word multiplied by 11.8.
Step 4: Subtract 15.59 from the result.
The specific mathematical formula is:

$$\text{FKRA} = (0.39 \times \text{ASL}) + (11.8 \times \text{ASW}) - 15.59$$

Where,

FKRA = Flesch-Kincaid Reading Age
ASL = Average Sentence Length (i.e., the number of words divided by the number of sentences)
ASW = Average number of Syllable per Word (i.e., the number of syllables divided by the number of words)

The scores were recoded and analysed for both the The Flesch Reading Ease and Flesch-Kincaid Grade Levels. A challenge in using the Flesch Reading Ease measure is that the test results are not immediately meaningful. To make sense of the scores, the researchers used conversion tables 1 and 2.

Score	Readability	Child/Teen Reading Level	Adult Reading Level
90-100	Very Easy	5 th grade	4 th grade
80-90	Easy	6 th grade	5 th grade
70-80	Fairly Easy	7 th grade	6 th grade
60-70	Standard	8 th and 9 th grade	7 th or 8 th grade
50-60	Fairly Difficult	10 th to 12 th grade	Some high school
30-50	Difficult	College students	High school graduate or some college
0-30	Very Difficult	College graduates	College graduates

Table 1 below shows Conversion Table for the Flesch Reading Ease Score

	Education	School/Level	Grade From	Grade To	Age From	Age To	Years	Notes
	Primary	Primary School	1	7	6	13	7	Education System: 7-3-2 (7 years of primary, 3 years of junior secondary and 2 years of senior secondary education) Duration of compulsory education: 10 years Primary School Leaving Examination (PSLE)
	Secondary	Junior Secondary Education	8	10	13		3	Junior Certificate Examination (JCE)
	Secondary	Senior Secondary Education	11	12	15	17	2	Botswana General Certificate of Secondary Examination (BGCSE)
	Vocational	Vocational Education in Teaching / Nursing						
	Tertiary	University						University of Botswana

Table 2 below shows the Botswana Education System Grade Levels.
Source: <https://www.classbase.com/countries/Botswana/Education-System>

The researchers discovered that four comprehension texts from the 5 that were put through the Coh Metrix test had a Flesch Reading Ease score of 30 to 50. The score is equivalent to college students or high school graduate and it should be difficult to read. Only one (1) comprehension text had a Flesch Reading Ease Score of 50-60. The 50-60 score is equivalent to a fairly difficult text and it is best suited for students who are in 10th to 12th grade (United States grades. The Botswana Education System Grade level was used to determine the grade level (see Table 2 on page 6). A grade 10 to 12 in the American System is equivalent to a junior secondary and senior secondary in Botswana.

CONCLUSIONS

The results of this study show that four(4) comprehension passages that were put through the Coh Metrix test do not match the intended audience and their reading abilities. This shows that the teachers might have overlooked the importance of addressing the issue of selecting appropriate texts for the targeted audience when they teach ESL learners. The study also shows that using computational approaches would help educators and other education professionals to distinguish texts that are appropriate for ESL learners. The study offers a comprehensive readability test method that is easy to follow and is also best suited for ESL teachers.

RECOMMENDATIONS

This research makes available important validity evidence for the growth of reading comprehension tasks for ESL learners. While more research is needed, this study contributes to the field by showing that a computational tool, Coh-Metrix, can be used by teachers and researchers to assess if the readers can understand the material selected for them. It is also important for teachers and educators to take note of the fact that ESL learners do not have the same reading competency levels as the native speakers of the language. Writers should therefore consider ESL learners and use computational readability tests to

check if the materials they provide is best suited for the target audience

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