*International Journal of Engineering & Technology*, 7 (4.35) (2018) 844-847

International Journal of Engineering & Technology

*Website: www.sciencepubco.com/index.php/IJET*

***Research paper***



# The Language of Civil Engineering: Corpus-based Studies on Vocational School Textbooks in Malaysia

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## Abstract

Engineering textbooks are specialized in nature, containing technical terminology which can be challenging to learners. For better comprehension of engineering concepts, there is a need for bridging the language gap by focusing on the frequently used and important engineering vocabulary. Most English Language Teaching (ELT) teachers do not necessary possess the specialist language in the field of engineering which can be rather confusing to them. It has been reported that Malaysian engineering textbooks (syllabus) were not written based on any word lists or corpora. Hence, learners require the language needed in the field of engineering – English for Engineering Purposes (EEP). To meet this requirement, specialised engineering textbooks were studied to specify the meaningful lexical components which can facilitate learners to assimilate into their discourse community. In the field of civil engineering, there is no exception that learners too need to understand the composition of words found in their textbooks. This study shows the exact word lists and suggests what learners and teachers can do to learn the "language of civil engineering".

***Keywords***: *Language of civil engineering; word list; terminology; vocational school; textbooks*

## 1. Introduction

Engineering students need be given exposure to actual learning materials in order to help them to be associated with their discourse community. Specific field students are believed to lack exposure to technical and sub-technical words in their respective fields [1]. Furthermore, these students are typically exposed to commonplace English only, not the kind of English that they need to assist them perform better in tertiary institutions (technical field) or even at workplace [16]. Thus, they want to be equipped with more specialized English like Engineering English or English for Engineering Purposes.

When students enroll in an engineering programme, they have to be taught the engineering language that professional engineers use daily in their workplace which is quite similar to those of the essential textbooks. Once they are accustomed to the engineering language, they will have a sense of belonging to the engineering discourse community [45]. Learning is most effective when students can apply what they understand parallel to the relevance of the content material as well as their capability to interpret the meaning. It is vital for instructors to have adequate facts and know-how about the types of vocabulary that will be taught to students in an English for Academic Purposes (EAP) or English for Specific Purposes (ESP) context, in order to amplify and enhance students' vocabulary knowledge in the subject matter. However, some instructors from social science backgrounds would find it hard to teach the technical phrases to college or university students as they are not experts in the subject matter [3, 47].

In Malaysia, the introduction of mathematics and sciences in English in 2003 aimed at assisting students to cope better into their discourse community. With regards to the creation of English for Science and Technology (EST) in the Malaysian context, it was once observed that it did not provide adequate assistance to students' comprehension of technical and semi-technical words in the respective fields. The "EST textbooks do not cover the language needs of each Science subject and the words provided in the vocabulary lists were insufficient to help learners cope with the complex and confusing scientific vocabulary"(p.254. [23]. Thus, in order to bridge the gap, a specialised corpus is needed to identify the "anatomy" of the materials created for a specific subject matter (civil engineering materials).

A corpus can be defined as an affiliation or a pool of texts often referred to as lexis. In linguistic terms, a corpus is a series of texts which can be converted into an electronic database, which means that it must be machine-readable [46]. A corpus can describe numerous patterns of how phrases are used. For instance, collocation is one component that can be examined [48]. Loading and distribution of phrases is another aspect researchers can or should focus [27]. The corpus for English in a specific discipline needs to have a series of words and it is apparent to find a small corpus representing a unique part of a language [20; 24]. By scrutinizing a corpus of a particular field, educators can discover the nature of the language used in the discipline more authentically [7]. In Malaysia, research on the introduction of a scientific English corpus has not been extensively carried out, particularly when it comes to the corpus creation using the textbooks [21]. "To our knowledge, there is hardly any corpus-based engineering material developed in the context of Malaysia" (p.1279) [41]. Hence, it is integral to have a specialised engineering corpus in the context of Malaysia.

Textbook is generally considered as 'a misfit in the learning-teaching environment' [27]. Many studies were carried out in the locality of English Language Teaching (ELT) material in comparison to which it indicated that most textbooks are frequently developed in an ad hoc manner. Looking from the perspective of corpus-based studies, these research indicated that the textbooks were developed through a manner of which it includes intuition and

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non-retrospect approach that is lacking in the region of lexical loading and distribution patterns [25, 26]. Materials need to be developed systematically based totally on the crucial words unique found in a discipline [21].

Despite criticisms, textbooks are viewed as an important element to learners, in particular in the English context as "the textbook becomes the major source of contact students have with the language apart from the input provided by the teacher" (p.1) [36]. Teachers rely on textbooks for the provision of task and test for students [21] and they furthermore encompass the framework and syllabus for academic direction [11, 12, 13, 14]. The most important situation is the effectiveness of the textbooks, especially in teaching vocabulary in a specific context. Even early development in ESP sought to identify precise and quintessential vocabulary in relation ESP materials development [16]. When it comes to teaching the required types of vocabulary in a classroom, it is important to provide them with a dependable word list to be integrated into their pedagogical approaches.

Most teachers and materials developers are believed to be non-experts in utilizing word lists in specific fields when using English language as the medium of education [19, 34, 40, 47]. Some teachers are also believed to be inexperienced in educating vocabulary using word lists like the General Service List (GSL) [49] and the Academic Word List (AWL) [4]. The core trouble concerning the Malaysian textbooks is that the books are now not primarily based on any fundamental word lists or corpora which would provide more authentic language features and precise vocabulary for learners in a specific discourse community. In addition, there is no empirical study about the text coverage statistics in terms of vocabulary categorization in Malaysian context. To date, there is a little knowledge about the text coverage of the Malaysian engineering textbooks as compared to the different word lists like the General Service List (GSL) and the Academic Word List (AWL). In addition, the need to conduct studies on word lists integration into the subject matter learning is believed to bridge the 'technical vocabulary' gap. These two word lists are integral as they provide the essence to English written materials especially in terms of frequently used meaningful words relating to a certain field.

In schools, the language used in engineering publications is frequently very technical or context-eccentric, which is too abstract or challenging. Second language users (students) lack the exposure to the effective usage of the target language which is required to be successful in 'technical communication' besides the needed linguistic education [22]. These freshmen need to be aware of complicated and challenging scientific ideas and terms which seem quite distant from their day-to-day things to do and experience [2]. The problem of ineffective educating of science in English in Malaysia [38] can be linked to the educating of engineering syllabus. The most important questions to ask an educator is 'what are the types of vocabulary an educator should teach?', 'when must the vocabulary be taught?' and 'how valuable is it to the classroom needs?' [10].

Identifying the type of words required would contribute to the effective comprehension in lessons. Since the most important focal point of this study is on the nature of engineering discipline (language) for upper secondary level and beyond, the first step in identifying the type of language used in engineering-centred classrooms is to create a corpus solely built on the of language used in the target discipline. It is essential to develop an engineering pedagogic corpus as there is no current corpus of the language of civil engineering in Malaysia academia context. Hence, this study focuses on analysing the prescribed engineering textbooks for vocational schools specifically in the field of civil engineering.

It has been assumed that the levels of lexical choices found in those textbooks are of the required standard believed to build the foundation of civil engineering language at tertiary level. Although it does not directly reflect the technical aspect of civil engineering, it deals with the lexical composition educators need to be aware of in order for the students to perform at their level best, especially when writing, communication and comprehension of language relating to engineering (civil) is concern. Since this is the pioneering study for civil engineering language in Malaysia, the object of the study is solely on vocational textbooks because it represents the population of the materials used by local students before they embark on tertiary education. In addition, the authors who wrote the textbooks are all local authors who know the localized field of engineering in Malaysia better than any foreign experts as well as the language used is of second language context for easier comprehension.

This study explores and determines the nature of the English language usage found in the prescribed civil engineering textbooks by means of figuring out its major traits and analysing the lexical patterns. The text coverage (vocabulary types) of this specialised engineering vocabulary is further evaluated to the essential word lists, namely the General Service List (GSL) and the Academic Word List (AWL).

The defined targets of the study are as follows:

1. To develop a civil engineering corpus using the Malaysian Civil Engineering Vocational Engineering Textbooks.
2. To investigate the similarities and differences in the vocabulary loading or distribution patterns of the civil engineering textbooks.

## 2. Methodology

Using the 'WordList' function of WordSmith Tools 5.0 [44], the lexical properties (characteristics) of the target corpus are obtained. From the outcome of the analysis, the tokens (running words), types and Standardized Types per Tokens Ratio (STTR) are shown for both target and auxiliary corpus. The word strength of each corpus is reported and compared. Manual calculation of the types per token ratio (TTR) can be done from the data provided for analysis. The characteristics of each term are further elaborated in the Results and Discussion section. There are a number of steps to answer this research question. . The step looks into the properties of the GSL words in the engineering texts versus the non-engineering texts to determine the similarities and differences. The result can be obtained via analysis using the RANGE software [9]. The initial assumption is that GSL words, in nature, are supposed to appear in General English texts more frequently than technical or academic texts. By running the RANGE software on all the corpora, this initial hypothesis can be proved to be true or false. The second section analyses the coverage of the academic words in the target corpus. This part determines the AWL coverage of the corpora for which the RANGE software is used.

## 3. Results and Discussion

The statistical distribution of the tokens and types of each sub-corpus and the target corpus provides an insight to the loading of words and lexical density as well as recurring ratio. The target corpus or the main corpus in this study is the Form Four and Five civil engineering textbooks developed for vocational school students with special disciplinary needs. Identifying the types, tokens and lexical variations (also referred to density ratio) of the target corpus would provide a better appreciation to the properties of the engineering corpus. The lexical properties of the auxiliary corpora are also discussed in detail in terms of the types, tokens and lexical density and recurring ratio. The results also show a lexical overview of all the corpora, with justification of which texts are more lexically dense, causing learners to be overwhelmed when using the texts as references. High lexically varied textbooks may hamper the learning process [27, Tomlinson, 1998). The process of deriving the tokens and types from the analysis of all the texts was completed using WordSmith Tools 5.0 which listed total number of tokens and word types sorted by frequency or alphabetical order. As explained in chapter 3, every single word in the texts is counted as a token, whereas each dissimilar word in the texts is considered as a type. For example, the word 'engineer',

'engineers' and 'engineering' are counted as three types and the tokens take into consideration how many times each word was found in the texts. The general statistics displayed by the concordance software are the number of tokens (also known as running words), the kinds of words (referred to as types), the type/token ratio (TTR) and the standardized TTR. The type/token ratio (TTR) is the number of types per token, giving an overview of the lexical density of words in the target texts. It has also been labelled as density ratio [1, 27, 35]. Type/token ratio is defined as lexical variation (LV) [18] and referred to it as the diversity of the vocabulary used in a corpus [42].

The higher the TTR, the more lexically dense the text is believed to be. It can be interpreted that the higher the TTR, the wider the lexical variation in a corpus. In other words, the higher the TTR, the more difficult the textbook is for learners to comprehend. However, TTR is only meaningful to the corpora of equal size and the sophisticated data is rather crude [18]. If the number of tokens or length of texts is equal, then TTR can be a good suggestion. Taking into consideration the limitation of English vocabulary, the tokens increase (with proportion) synchronously to the text size but not the type, causing the augments of the type to be smaller and hence, making TTR meaningless [15]. Thus, the standardized type/token ratio (STTR) needs to be used for this purpose. STTR allows researchers to compare corpora or texts of different sizes as STTR is an average of type/token ratio based on consecutive chunks or texts [50]. The WordSmith 5.0 program was used as the computational tool to evaluate STTR, and a formula is pre-programmed in the Wordlist function of this software. STTR is computed in such a way that the Wordlist function in the WordSmith 5.0 would run the analysis at every 'n' word interval in the text file. For WordSmith 5.0, the default setting is 'n' = 1,000 and this default setting is used in this study. This means that the TTR is calculated for the first 1,000 running words and then calculated afresh for the second 1,000 running words, and the same process goes on until the end of the loaded text files. An average STTR is obtained, meaning that the average TTR of consecutive 1,000 word chunks of text is computed. The higher the STTR, the more lexically varied the text is. For the presentation of the analysed results of this study, the general statistics of every corpus used include the tokens, types, TTR and STTR for comparative corpora analysis.

**Table 1:** General Statistics of the KBSM Form Four and Five Civil Engineering Corpus

| KBSM Form Four and Form 5 Engineering Textbooks | Tokens | Types | Density Ratio [Types/Tokens Ratio (TTR)] | Standardized [Types/Tokens Ratio (STTR)] |
|---|---|---|---|---|
| Civil | 97227 | 6654 | 6.84 | 30.98 |

It was found that a high type-to-token ratio signals low repetition of each word in the texts, having high density of words with some variations. Thus, it indicates that a particular text has a higher level of difficulty with wider range of vocabulary. The TTR in science journals ranges from 4 to 7 based on simplistic type-to-token ratio calculations [17]. If the STTR value is 31, it indicates that there are 31 word types in every 1000 words in the corpus. High STTR suggests high lexical variations or diversities in the corpus and the opposite can be true [43, 44]. A low STTR would mean that many of the similar types are used repeatedly and a high STTR shows that the corpus encompasses a large variety of words, which means fewer words are repeated [37]. In short, the textbooks of civil engineering for Malaysian vocational schools students can be overwhelming for them to comprehend, let alone understanding more on the engineering principles.

To achieve the second objective, the composition of the following two word lists was used as benchmarks. The GSL [49] was used as a benchmark of high frequency words. In other words, all the common English words are assumed to be covered by the GSL. The list is "very important because these words cover a very large proportion of the running words in spoken and written texts and occur in all kinds of uses of the language" (p.13) [31]. High frequency words are the most 2,000 frequent words in English and students should put in efforts to learn them due to their text coverage in the texts [28, 29]. The classic list of the high frequency words is the GSL, containing 2,000 word families [4, 8, 30, 31, 51]. "Although the GSL has been criticised for its age and size, it accounts for 90% of coverage in fiction texts, 75% of nonfiction texts and approximately 80% of the running words in academic texts" (p.28) [51]. This list has been tested through the years and it still has its significant relevance to the field of ELT [4, 8, 32]. In short, the coverage of the GSL in any texts should not be disregarded in any vocabulary analysis. For this reason, the composition of the engineering texts should be determined in terms of the GSL word families if the engineering texts contain high or low GSL properties in their vocabulary distributions.

The other list featured in this study to be analysed is the AWL [4]. The AWL is believed to be the scale of academic vocabulary, as it is the most widely used list of academic vocabulary in language teaching, testing and pedagogical materials development [39]. Academic vocabulary is addressed as sub-technical vocabulary because it does not include technical words but formal vocabulary [33]. Sub-technical words are defined as "context-independent words which occur with high frequency across disciplines" (p.391) [3].

**Table 2:** Coverage of the KBSM Civil Engineering Textbooks by the GSL and AWL

| The KBSM Civil Engineering Textbook | | |
|---|---|---|
| Word List | Tokens (%) | Cumulative percentage coverage in tokens |
| GSL (1,000 & 2,000) | 72.72 | 72.72 |
| AWL | 10.99 | 83.71 |
| Not in the lists | 16.29 | 100 |

It seems that the GSL words appeared very often in these textbooks, as they accounted for more than 70% of coverage in all the textbooks. It implies that the GSL words coverage is essential even in technical textbooks like those of the civil engineering textbooks. These findings for the GSL coverage were quite parallel with that of the coverage reported in analysing the science (natural) textbooks [1, 6].

AWL accounts for almost10% of text coverage in academic texts [4]. However, the AWL performed better in the target texts. Although there were no any engineering texts in the 3.5-million-words AWL corpus [4, 5], the data from this study showed that the AWL words are still relevant to the civil engineering texts. It means that the AWL words can also assist students in understanding engineering texts. If the upper secondary engineering students master the AWL, they increase the chance of vocabulary learning, especially those of technical fields. The rest of the off-lists words or vocabulary is believed to the technical civil engineering words which students with pick up with time or when they are more professionally developed.

## 4. Conclusion

In conclusion, the language of civil engineering, in the eyes of many learners whose English is not their first language can be challenging, if not overwhelming with the textbooks. It is suggested that a more 'vocabulary-friendly-engineered' textbooks can be produced to affectively and effectively deliver the content of civil engineering to the students. In addition, it is evident that not only does the GSL and AWL constituted a large chunk of word families in the General English texts, but the same also applied in those of the engineering texts. It is suggested that engineering learners to be more familiarized with specialised word lists as the basis to acquire more specific words to bridge the vocabulary gap. Thus, the findings from this analysis clearly state and suggest the use of the combination of the GSL and AWL (due to the significant text

coverage) to achieve better text coverage in comprehending the texts. The textbooks analyzed serve as fundamental or even foundation to develop more useful textbooks or word lists for more potential study. Since the methodology is validated, it can be duplicated for foundation/diploma level textbooks/materials which are almost similar or a level higher than vocational school materials.

## Acknowledgement

The authors are grateful to Tenaga Nasional Berhad, Malaysia for the funding of this project under the title of "VIRTUAL GEO-HAZARDS MONITORING AND ASSET MANAGEMENT SYSTEM (SOCIETY ENGAGEMENT)".

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