Dissemination Article:
A Text Difficulty Analysis Tool
for Developing Extra-Curricular Reading Materials

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1 Introduction

Since extensive reading is important for language learning, students should engage in extra-curricular reading as much as possible. To facilitate efficient learning, the difficulty of the reading materials should match the reader's language proficiency: an overly easy text would not stretch the student's linguistic skills, while a very challenging text could be discouraging and may not be even understood by the student. Language teachers therefore need to carefully select materials at an appropriate level of difficulty, and adapt them if necessary. Since this can be a time-consuming process, teachers would benefit from an intelligent text analyzer that provides assistance in editing reading materials.

2 Presentation of *Text Difficulty Analyzer*

As part of a project supported by the Standing Committee on Language Education and Research (SCOLAR), we have developed *Text Difficulty Analyzer*, a software tool that assists teachers in preparing reading materials in Chinese. The tool automatically determines the difficulty level of a text, in terms of school grades in the Hong Kong education curriculum. On the basis of a graded vocabulary list from the Education Bureau, the tool estimates the vocabulary complexity of the text with respect to students at the target school grade. To support text revision, it highlights words that are expected to be new vocabulary, and suggests alternatives that better fit the expected vocabulary proficiency of students at the target grade. We now present the tool through a typical work cycle, in which the user first analyzes the difficulty of the text (Section 2.1); adjusts the parameters (Section 2.2); and then revises the text (Section 2.3); and possibly with reiterations of the cycle until the text is ready.

2.1 Analyze text difficulty

As the initial step, the tool analyzes the difficulty of the text with an AI-based assessment model trained on a large corpus of textbook passages. It also estimates the vocabulary coverage of the text at any target grade, i.e., the percentage of words that are known to the typical student in that grade. Figure 1 shows the profile of a text with the target grade set to Grade 1. As indicated in the leftmost tab on top, 79.2% of the words in the text are predicted to be known to the typical Grade 1 student. Vocabulary that is new to Grade 1 students are color-coded, with deeper colors indicating a higher level of difficulty: from light blue for Grade 2 words (e.g., 偉大 *weida* 'great'), to deep blue for Grade 6 words (e.g., 反射 *fanshe* 'reflect'), to black for words above Grade 6 (e.g., 闌尾炎 *lanweiyan* 'appendicitis'), i.e., words that are not in the vocabulary lists.

2.2 Adjust parameters

In this step, the user adjusts word boundaries and word grades. If the vocabulary profiling results contain word segmentation errors, the user can immediately revise the word boundaries
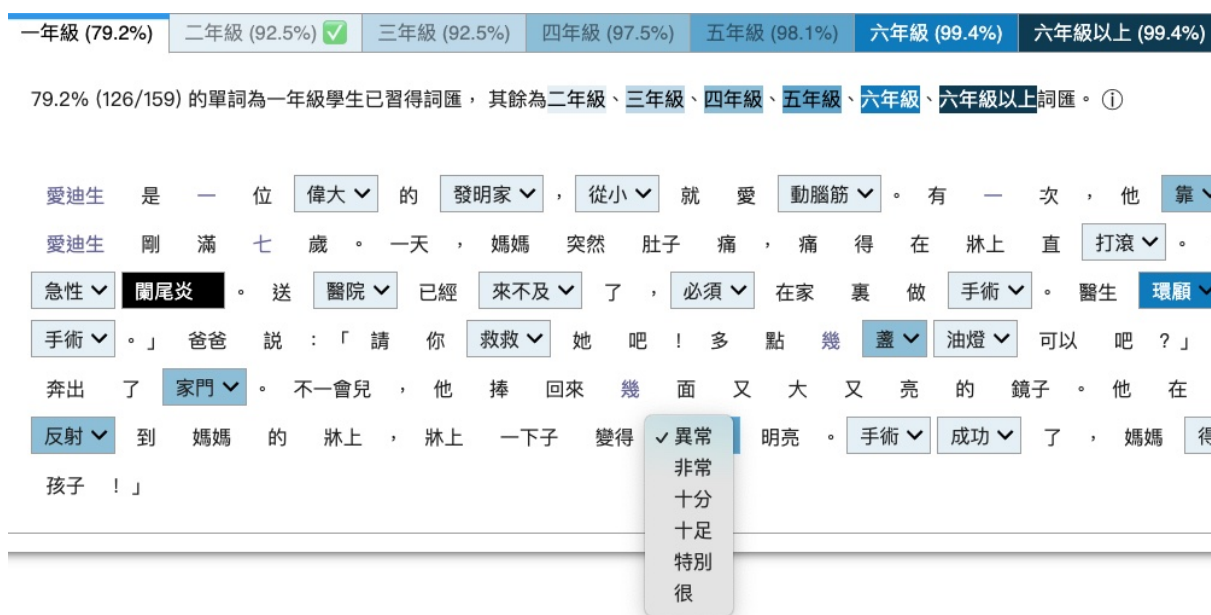
Figure 1: Interface of *Text Difficulty Analyzer* providing feedback on a Chinese passage: (1) **Vocabulary profiling**: Words expected to be new vocabulary at the target grade (Grade 1) are highlighted; words at different grades are color-coded from light blue to dark blue. (2) **Text revision**: For each highlighted word, a drop-down list suggests simpler substitutions.

in the text input field by inserting and deleting white space. Further, if the user disagrees with the grade of a word, he or she can dynamically revise the vocabulary list or add new words. After these adjustments, the user can refresh the profiling results.

2.3 Revise

When the estimated grade of the text deviates from the target grade, the user may wish to revise the text to the target. To assist in this task, the tool provides lexical substitutions. For each difficult word, a drop-down list offers word substitutions that conform to the target grade. Consider the sentence '... the bed suddenly became unusually bright' in Figure 1. The word 異常 *yichang* 'unusually' is highlighted as a Grade 5 word since it exceeds the target grade (Grade 1). The user can click on the word to open a drop-down list, which contains simpler words with related meaning. In this case, the drop-down list proposes the words 非常 *feichang* 'extremely' (Grade 1), 十分 *shifeng* 'very' (Grade 1), etc. After clicking on a suitable word in the list to apply the substitution, the user may re-analyze the difficulty of the text (Section 2.1) and possibly repeat the cycle until a satisfactory version of the text is obtained.

3 Conclusion and Recommendations

Text analyzer tools have already been developed for a variety of languages on various difficulty scales, including the CEFR (Common European Framework of Reference for Languages), or the HSK (*Hanyu Shuiping Kaoshi*) framework, etc. To our knowledge, however, this is the first one to aim specifically at the Hong Kong education setting. Evaluation results have shown that users can efficiently assess the difficulty of a text and revise it with assistance from the tool.

Looking forward, we recommend that language teachers and other frontline practitioners make use of automatic text difficulty assessment, which can offer an objective estimate as a complement to one's professional judgment. During preparation of pedagogical or examination materials, it is well worth considering the use of a text analyzer tool to identify words that are

above the target grade, and to obtain editing suggestions for more efficient revision. Finally, schools should be informed of the potential advantages and pitfalls of integrating automatic text difficulty assessment into the process of lesson preparations and examination paper review.