Components of Chinese Reading Comprehension Placement Test for Singapore Primary School Students

Tzemin Chung, Mun-Kew Leong, Peing Ling Loo, Qiuxue Si, and Arthur Soetanto

***Abstract*—This study investigated the types of reading comprehension questions that better discriminate between students of high and weak Chinese reading comprehension abilities in junior elementary grades. A total of 127 Primary 1 and Primary 3 students took part in this study. As the placement test was long, it was group into three smaller tests (L1, L2, and L3) for students with high, medium, and low reading comprehension abilities. Placement test scores were correlated with their Chinese language exam scores to find out if the placement test could accurately differentiate students with different reading comprehension abilities. Performance on each question was also analyzed to find out if they were good discriminators. Results indicate that placement test scores correlated significantly with school exam scores. Hence, there is evidence to support the claim that the placement test could discriminate between students with varying reading comprehension abilities. Moreover, question difficulty indices and question discrimination indices showed that questions that require high level of discourse processing ability were good discriminators for older, higher-ability students.**

***Index Terms*—Chinese reading comprehension, placement test, discourse processing, learning of mother tongue.**

I. Introduction

Reading comprehension is a complex cognitive process [1]-[3]. Children need to be instructed to complete such a task [4] and perform better after such instruction, e.g., when Grade One students were exposed to word characteristics, their word identification strategies improved significantly [5]. When instructing children, it is necessary to provide them with reading materials appropriate to their reading levels; this frees them from struggling with unfamiliar words so that they can read for the meaning of the text [3]. In fact, when children have the meaning of sight words in their memory, they rarely make semantic errors [6]. Chinese is the second school language for ethnic Chinese in Singapore. It is referred to as "Mother Tongue" in the education system. While mother tongue is normally thought of as the language learned by children and passed from one generation to the next (wordnet.princeton.edu/perl/webwn), it is not so in Singapore as many children do not speak or learn to speak Chinese anymore at home [7]. The rise of China as an economic superpower, however, has pushed education authorities to improve students' standard of Chinese. However, schools are not organized in a way that promotes effective teaching of Chinese: students are put into a class based on academic and not on Chinese ability. Since the medium of instruction in all other subjects is English, the Chinese language ability in a class can vary greatly depending on personal language ability, interest, and home support. Moreover, these classes are large with about 30 students in each class. For students to improve in reading ability the support (including appropriate levels of reading materials) provided in language tasks should be adjusted according to the past experience and the current needs of the student [8]. The challenge for the school is thus in providing the correct reading materials to each student in a large class of mixed ability students.

From the above, it follows that grade is not a good predictor of Chinese language reading comprehension ability. For example, should you provide a child who aces a Primary Three (P3) reading comprehension task the same materials as another child who failed? This becomes more complicated when you cross grade levels, e.g., what level of reading materials would you provide to a P3 child who failed a P3 comprehension task compared to a Primary Two (P2) child who did well in a P2 comprehension task? Hence, there is a need to develop a placement test to measure reading comprehension ability on a standardized scale. Based on where children place on the scale, appropriate reading materials can then be provided.

II. Components of Reading Comprehension

A. Survey of Literature

At the elementary grade levels, word reading, which include word naming speed and phonological awareness, are found to be related to the development of reading skills [9]. Phonological awareness and word naming speed were good predictors of reading outcomes and good discriminators that separate average and good performers from weak ones.

When probing deeper, Scott [3] investigated the influence of "word recognition, vocabulary, spelling, word level grammatical concepts and effective word choice" (para. 2) on reading ability. Scott found that in addition to phonological awareness, knowledge of words was a good predictor of reading comprehension performance among first and second grade students. Similarly, Connor and Zwolan [10] studied reading comprehension performance with cloze passages that required the application of syntactic, vocabulary skills, and comprehension strategies. They found that these skills are interrelated and children with better skills had better performance in reading comprehension tasks.

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In addition, Cromely [11] indicated that children weak in word reading did not seem to be able to understand the passage they read and if they did not perform well in one measure, they also had low scores in all measures. These children also had difficulties in summarizing and inference tasks. Cromley therefore investigated whether the ability to infer was related to performance in reading comprehension. She found that children with the ability to make inferences in a range of tasks (e.g., moral evaluation, inferences within passages, and inferences that make use of background knowledge) had better vocabulary, employed more accurate strategies and achieved higher free recall scores.

These findings agree with studies done in Chinese reading comprehension. Chik, et. al. [12] worked with Chinese elementary grades students at different grade levels in tasks to arrange either three, five, or twenty sentences into a logical text passage. They found that at elementary grade levels, word-reading skills such as word meanings were a good predictor of reading comprehension performance. At the senior level, however, word-compounding skills were the more appropriate predictor for reading comprehension performance.

These studies point to multiple factors at work in predicting reading comprehension performance, advancing from word-level processing to higher level of discourse processing. In view of the possibility of multiple factors influencing reading comprehension, Meneghetti, Carretti, and De Beni [2] found it simplistic to rely on a single factor to predict reading comprehension performance across grade levels. They therefore proposed and measured ten aspects of reading comprehension, including meta-cognitive knowledge and control processes, in third to sixth grade students. The ten aspects, from basic to complex level of cognitive processing, were as follows:

1) Characters, Times and Events: were students able to identify main characters in the story, when events took place and their durations;
2) Events and Sequences: were students able to identify a logical or chronological sequence of the events in the passage;
3) Syntactic Structure: were students able to derive meaning from the syntactic structure of phrases, clauses, and sentences;
4) Connections between parts of the text: were students able to accurately create meaning of the passage by logically or semantically connecting different parts of the text;
5) Inferences: were students able to accurately create meaning from information not explicitly stated in the passage;
6) Text Sensitivity: were students able to identify information or purposes of the author from the different text types;
7) Text Hierarchy: were students able to identify major and minor ideas in the passage;
8) Mental Model: were students able to build a mental representation of the passage;
9) Text Flexibility: were students able to monitor and reading comprehension strategies based on text types or task requirements.

The first five aspects are basic level processing while the other five are complex. Meneghetti, Carretti, and De Beni [2] also used three text types in their study, namely, narrative, descriptive and argumentative passages. They attempted to find out if reading comprehension is a unique construct or it has various levels of processing, that is, basic, cognitive, and meta-cognitive. Knowledge of these aspects is essential in helping students improve their reading comprehension. Results from their study showed that a two-factor model could better account for reading comprehension performance. When attempting reading comprehension tasks, children not only applied basic skills such as recognizing events and time in a passage, they also engaged sophisticated cognitive processing (such as integrating information in the text with prior knowledge) to build a coherent mental representation of the passage.

B. Components of Chinese Language Reading Comprehension

In the present study, we intend to construct a placement test blueprint for Chinese language reading comprehension. There exists a large corpus of materials that test Chinese language reading comprehension in Singapore which comprises the curriculum and examination papers as well as independently written assessment papers for self-practice and revision. However, these materials are grade level specific so they cannot be standardized across grade levels or student performance, they do not explicitly refer to underpinning theory to pinpoint which aspect of student performance is being tested in which question(s) and the various components are not ranked in order of cognitive ability levels. This ranking is important as it correlates well with reading comprehension ability across grade levels [2, 12].

To create the blueprint, we analysed the corpus of exam and assessment materials to identify components of reading comprehension that were already familiar to local students. Then based on the findings by Meneghetti, Carretti, & De Beni [2], we proposed additional components that assessed cognitive ability levels. The composite blueprint was then validated by discussion with practicing Chinese language school teachers and with a professional Chinese reading comprehension assessment developer. The following components were included in the overall blueprint: 1. Word Reading (recognition of text based on phonetics, recognition of radicals in Chinese characters, collective nouns); 2. Language Comprehension (syntax); 3. Recognition of characters, time, events; 4. Events and Sequences; 5. Connection between parts of text; 6. Inferences; 7. Text Sensitivity; 8. Text Hierarchy; and 9. Mental Model. Details of these components are described later in the Materials subsection.

With this placement test blueprint completed, we created a standardized test to place the students and from there, provide the reading materials appropriate to their levels of understanding, and hence to their ability to read to the meaning of the text. Three studies are planned to validate the blueprint: first, at an intra-grade level basis; second, across two grade levels, and finally across all six levels of students at the primary school. This paper documents this initial development of the standardized test and the results of the

first study conducted in a Singapore primary school. The test was conducted on a computer platform for uniformity.

The intention in the first study is to confirm whether the test blueprint produces questions that are able to discriminate reading comprehension ability at a single grade level. We start with a single grade level because we have school Mother Tongue examination performance scores for the classes in our study. The standardized test must at least correlate well with the student performance at a single grade level. Additionally, as the schoolteachers questioned the unusual test format (which were distinct from curriculum examination format), we needed to confirm that students were indeed able to perform the test. Overall for the first study, the research questions were the following:

1) Does student performance on the standardized test correlate well with their examination performance?
2) At lower elementary grade levels, do lower cognitive processing questions better discriminate student reading comprehension abilities?
3) At higher-grade levels, do higher cognitive processing questions better discriminate student reading comprehension abilities?
4) Can this set of questions be used in a real school Chinese language environment?

III. Methods

A. Participants

The participants were from a neighbourhood primary school. There were four Primary 3 (P3) classes, comprising one high-ability, two medium-ability and one low-ability class, for a total of 83 eight to nine-year old students. There were also three mixed-ability Primary 1 (P1) classes totaling 44 six to seven-year old students. Note that students in P1 are not grouped into classes by ability.

B. Materials and Procedures

We constructed the placement test with a total of 99 questions that covered text passages and questions suitable for kindergarten (6-year) to 10-year-old children. For ease of administration in the school (requested by the teachers), the test was divided into three portions (L1, L2, L3) corresponding to expected difficulty. This was to avoid lower ability students (e.g., those in lower grades) doing questions obviously beyond their capacity, and for higher ability students to avoid doing questions that were too easy. The questions in each portion, however, covered the categories in the test blueprint. One mark was awarded for each correct answer; no marks were deducted for wrong answers. A description of each type of question is reported below:

Word Reading – The aim is to measure the ability of students to connect written characters and spoken sounds. Phonetic skills help young children to start reading. Questions may include, for example, the identification of the correct phonetics, or pinyin, for a Chinese word taken from the passage.

Language Comprehension – The aim is to measure whether students know the meaning of words and sentence structure.

Characters, Times and Event – The aim is to measure if students have a basic understanding of the story by being able to recognize the characters, various events which have taken place in the story and when they occurred. Questions in this category require students to identify why an event takes place based on the description in a certain paragraph.

Events and Sequences – The aim is to measure the ability of students in deciding the logical sequence or chronological order of main events. A question may, for example, require the re-ordering of events.

Connection between parts of the text – The aim is to measure the ability of students to connect parts of the text to construct a coherent meaning for the passage.

Inferences – The aim is to measure the ability of students in extracting meaning from what is not explicitly stated in the passage. Questions in this category may require students, for example, to infer the consequence of an act that is not explicitly mentioned in the passage.

Text Sensitivity – The aim is to measure the ability of students to identify relevant information required to make a decision. A question may, for example, ask students to read a passage and identify a title for it.

Text Hierarchy – The aim is to measure the ability of students to deduce the correct order of importance of elements in a text. Questions in this category may require students, for example, to identify a collection of similar ideas, a causal relationship, or a solution to a problem.

Mental Model – The aim is to measure the ability of students to identify the main ideas of an event or main ideas in the passage and construct an accurate mental representation. Questions in this category may require students, for example, to identify the thoughts of a character in the passage when a particular event occurs, predict the consequence of an action, or find a solution to a problem.

The test was administered to the students in the computer lab during their computer-based lesson time. The P3 classes were given the test according to their class ability, i.e., the low-ability class did L1, the medium-ability classes did L2 and the high-ability class did L3. All the P1 classes, however, did L1.

IV. Results

Placement test scores were correlated with the students' mid-year Chinese exam scores (Table 1). The exam consisted of a reading comprehension section. Hence, the exam scores can act as a proxy for students' reading comprehension abilities.

Results showed that each portion of the placement test significantly correlated with the exam scores. They give us confidence that our placement test is measuring the reading comprehension ability of students.

Next, we investigated how well the questions were able to discriminate students with high and low reading comprehension ability. Questions were ordered from low to high cognitive processing levels. The difficulty index, specified as the % of students who got the question correct, was calculated for each question. Hence the lower the

difficulty index, the harder the question. The discrimination index for each question was calculated and is defined as the difference between the proportion of correct answers for the top 27% of the students and the lower 27% of the students. The larger the difference, the better that question is to discriminate between high-ability and low-ability students

TABLE I: CORRELATION COEFFICIENT FOR PLACEMENT TEST SCORES AND SCHOOL MID-YEAR CHINEES EXAM SCORES

Class		Correlation Coefficient	*p* Value
P3	High-ability	.65	.001*
	Medium-ability (2 classes)	.58, .51	.004*, .006 *
	Low-ability	.55	.006*
P1	Combined 3 classes of mixed-ability	.59	<.001*

Note: * Significantly correlated

Results from the three tests indicate a general trend (see trending lines in Fig. 1, 2, and 3). First, as questions required higher levels of cognitive processing, fewer students answered them correctly. Second, as questions require higher levels of cognitive processing, their discriminatory power went up. This trend is most pronounced in the P3 high-ability class as the reading material (L3) was at an optimal level for them. Fig. 1 indicates the L3 relationship between question difficulty and discriminatory power. The easier the question, the less it is able to discriminate between high-ability and low-ability students, as a high proportion of students will answer it correctly. A question with a discrimination index of .25 is considered a good discriminator [13]. All except one question in L3 did not have discriminatory power (the question was too easy with an discrimination index of .13). From Fig. 1 (see questions f to m), we can see that except for one question (question k), the values of the discrimination indices increase as the level of cognitive processing required to answer the discourse questions increases. In contrast, although discrimination indices for low cognitive process questions show an upward trend, they fluctuate much (see questions a to e in Fig. 1).

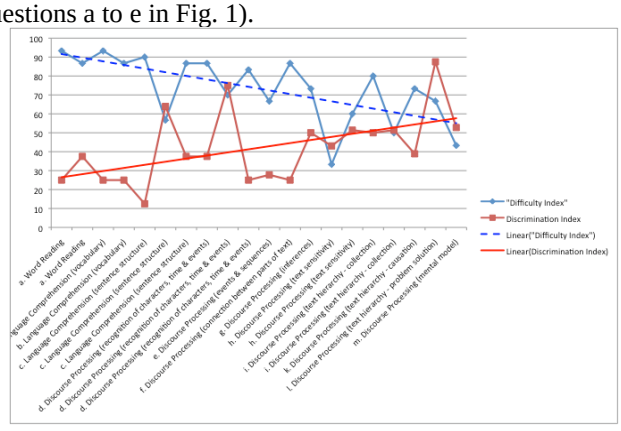

Fig. 1. Difficulty index and discrimination index for the Primary 3 high-ability class

Similar trends were found for the L1 and L2 tests (Fig. 2). Medium-ability children did not perform well on questions that required higher cognitive processing skills as indicated by the relatively lower question difficulty indices for questions that required higher level discourse processing abilities. In addition, questions that have good discriminatory power are lower level discourse processing questions (e.g., recognition of time, events, places, and event sequences questions). There were nine such questions as opposed to only six high level cognitive questions with good discriminatory power. The question that represents the highest cognitive processing ability, i.e., the question on mental models, had a medium difficulty index (.57) but low discriminatory power. It indicates the possibility of random guessing. It is hence not a suitable question at this level and it will be discarded. Furthermore, questions on word meaning and sentence structure did not discriminate between students who had high reading comprehension as opposed to low reading comprehension abilities. Only four questions had discriminatory power and among the four, only one had high discriminatory power.

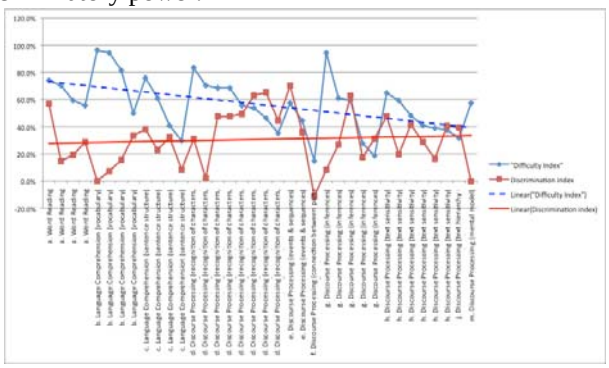

Fig. 2. Difficulty index and discrimination index for the Primary 3 medium-ability classes.

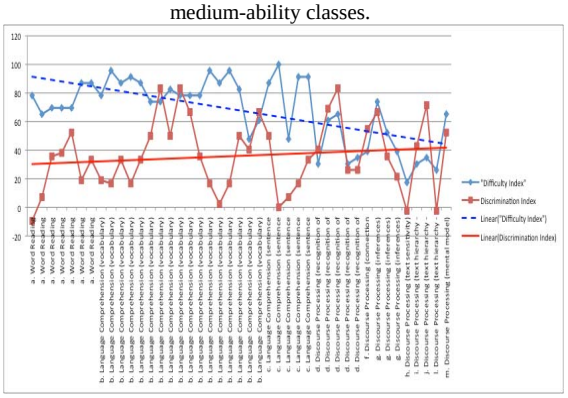

Fig. 3. Difficulty index and discrimination index for the Primary 3 low-ability class

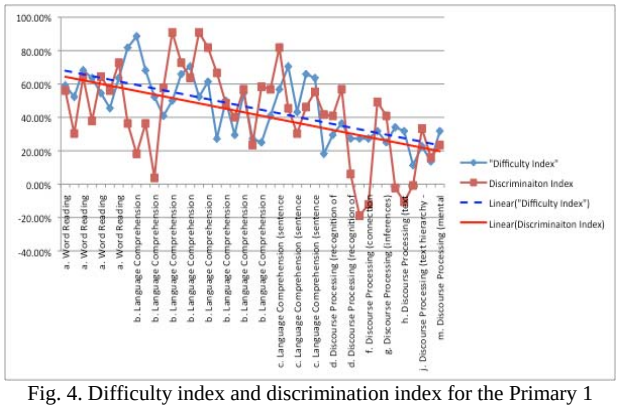

Fig. 4. Difficulty index and discrimination index for the Primary 1 mixed-ability classes.

For the P3 low-ability class, the discriminating questions covered some discourse processing question types and a large amount of word meaning questions (Fig. 3).

L1 test results showed that language comprehension, i.e., vocabulary, discriminated between high-ability and low-ability students (Fig. 4). The discriminators for the three tests changed from high-level discourse processing question

for high-ability P3 students to low-level discourse processing questions for medium-ability P3 students, to word meaning questions for P1 students.

V. Discussion

Findings from the current study showed that the test blue print that covers both high and low cognitive processing questions types could differentiate reading comprehension ability, despite schoolteachers' concerns that the questions did not resemble those commonly used in school practice or exams. Results also confirm previous findings that questions that require high level cognitive processing ability better discriminate reading comprehension ability at the higher-elementary grade levels. Our results showed the trend that at higher-grade levels (9 year-old children with high Chinese abilities), questions that require high level of discourse processing ability such as questions that access students' mental models were good discriminator of student reading comprehension ability. Questions that tap only low discourse processing ability were good discriminator for medium reading comprehension ability. Questions on word meaning, on the other hand, did not require discourse-processing ability. They were good discriminators for low reading comprehension levels such as students in kindergarten or P1. As the placement test was administered in a real world school environment to seven classes of students, we can conclude that it can be used in the Singaporean school environment.

In the near future, we will move on to cross-grade level testing to find out if the placement test can place different ability students from different grades on the same measurement scale. We will also create an adaptive test that will automatically retrieve appropriate questions for each student, thereby increasing the accuracy of the test.

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