From Numbers to Words: An analysis of errors made by students by dyslexia

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INTRODUCTION

It is widely acknowledged that any natural number can be expressed in three forms: its Arabic-numeral form (also known as symbolic form), its word form and its non-symbolic form (such as repeating the same shape to represent the quantity). The ability to read and recognize numbers is one of the basic skills in mathematics. Research has found that children's ability to recognize number in kindergarten is a good predictor of their mathematical achievement in first grade (Hornung, Schiltz, Brunner & Martin, 2014).

The process of translating numbers from one representation to another is called transcoding. In this research, we are interested in the challenges students with dyslexia encounter in the process of transcoding numbers from their Arabic numeral form to their word equivalent. Dyslexia is a specific learning difference caused by a core deficit in phonological processing. This results in one having significant difficulties with reading, writing and spelling. It can also be accompanied with other secondary deficits such as poor working memory, slower retrieval speed and poor comprehension. The researchers of this study noted that most of the Primary Four students (between 9.5 to 10 years old) with dyslexia on the DAS Maths programme had difficulties with expressing numbers in words. This study seeks to explore the challenges these students have with expressing 5-digit numbers in words by looking at the types of errors they were making in this task. It is hoped that by studying their patterns of errors, teachers would be able to develop strategies to help students effectively.

METHOD

Thirty-four Primary Four students from the DAS Maths programme took part in this study. This programme is an intervention-based programme which seeks to identify the difficulties students with dyslexia have with understanding of Math concepts, the language of Maths and proficiency in Mathematical skills and to address these difficulties through dyslexia-friendly Math remediation.

At Primary Four, students are expected to express up to 5-digit numbers in words. To determine the participants' mathematical competence in this skill prior to formal teaching, the participants were given the following item in a pen-and-paper test at the beginning of the school year :

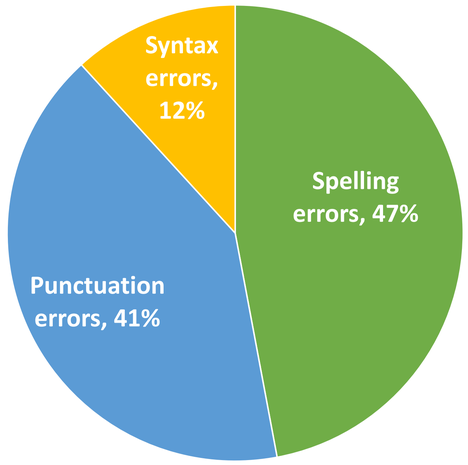
Express 27 948 in words

_____

This item was designed such that its word form contains a mix of both phonetically regular words and sight words. The use of the digit "0" was also avoided to ensure more regularity in its syntax. Their responses were analyzed both quantitatively and qualitatively to determine the types of errors made and the frequency of the errors.

RESULTS

- A total of 51 errors were made. These errors could be classified into:

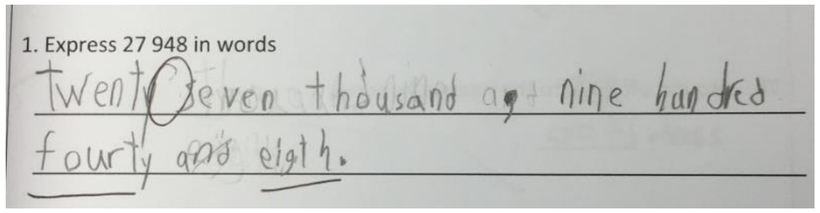


- Spelling errors can be further classified as:
  - Look-alike errors (where the response looks similar to the correct spelling of the word; for example: sveven)
  - Sound-alike errors (where the response sounds similar to how the word is supposed to be read; e.g. savn).

- The spelling strategies employed consisted of a mix of phonics and spelling by sight, but most attempts resulted in more look-alike errors than sound-alike errors, which suggests that the participants were using their sight memory more than the phonics strategy to spell.

- Punctuation errors consisted of omissions of the hyphen for numbers such as "twenty-seven" and "forty-eight", as well as omissions of the comma to break up the sentence structure into its constituent parts. Although these errors do not affect the meaning of the numbers, they are worth noting as they are conventions required of students in the local educational system.

- Syntax errors could affect the meaning of the given number. Such errors include the omission or inappropriate use of the connector "and", as well as the omission of place value words such as "thousand"



A response showing a mix of spelling, punctuation and syntax errors.

DISCUSSION

- The results observed are consistent with the language skills of people with classical dyslexia.

  → Spelling is also an important skill in Mathematics.

- The fact that only a few participants had difficulty expressing the number with the correct sentence structure shows that people with dyslexia do not need to have a lot of experience with 5-digit numbers in order to express it in words.

- The participants directly mapped the digit to the respective place values. However, punctuation and the connector word "and" seem to be missing.

  → This suggests that perhaps most of the working memory capacity was spent on trying to produce the number using the appropriate sentence structure, and therefore little attention was given to surface features.

LIMITATIONS & AREAS FOR FUTURE STUDY

- This study looked at the participants' responses to one item: expressing the number 27 948 in words. While the qualitative analysis yielded rich data, it is insufficient to help us develop a theory of how people with dyslexia transcode numbers from the symbolic Arabic numeral form to word form.

→ Future studies should include a variety of items ranging from 2-digit to 5-digit numbers and assess students' performance in transcoding such numbers in words.

→ There should also be a mix of items where the sentence structure of the numbers is regular and irregular (that is with 0 as a placeholder in one of the place values).

→ Having more items from each category would increase the reliability of the results.

- As spelling ability might mediate the participants' ability to express the number in words, participants should go through two conditions: one where the participants reads out the number; and another where they have to write out the number in words.

- It would also be interesting to see if there is a relationship between students' scores when they transcode number to words and vice versa, and whether perhaps performance in one could predict performance in the other.

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