Does reading comprehension competence determine level of solving mathematical word problems competence?

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Abstract. This study aims to investigate the interaction between problem solving skills in mathematical words and reading comprehension. The method used is correlational by linking reading comprehension competence and ability to solve mathematical word problems. Participants were 300 children aged 9-10 (Grades 3 and 4) taken from 3 school clusters of low, medium and high categories from various aspects. Reading comprehension skills in text and children's mathematical word problem solving performance are tested. The results showed that the ability to read comprehension had a very strong relationship with the ability to solve mathematical word problems. The ability to understand the relationship between words and words in a sentence that contains problems is crucial for students to solve mathematical word problems. The school cluster chosen also influences the level of children's mathematical word problem solving ability and reading comprehension skills. From the results of this study, researcher recommend teaching reading and counting in elementary schools be carried out in an integrated manner.

1. Introduction
The ability to read and count students in various countries has attracted a lot of attention from researchers. Children's reading skills greatly affect their math skills [1]–[3]. However, not much is known about how linguistic processes are used to solve problems in logical-mathematical reasoning. Mathematical skills and reading skills have been shown to have a very close relationship [4]–[6]. Previous research has also shown that arithmetic difficulties are associated with the development of reading skills. In addition, studies looking at the abilities of children with limited learning abilities have shown that reading and math difficulties often co-exist [6], [7].

This study strengthens previous research, namely the relationship between problem-solving skills in mathematics and reading comprehension skills. However, in this study, the two abilities were linked to the school cluster. The reason for choosing school cluster variables in this study is that the researcher wants to see the role of the school cluster in influencing the relationship between mathematics and reading abilities. Previous research has shown that both skills are related to overall reasoning skills. Strategies for testing reading and numeracy skills are the ability to classify math problems, word structure, question types, and reading comprehension. [8]–[10].
Mathematical skills can be evaluated in a number of ways, for example counting with written or spoken instructions. One way to look at math skills in the context of traditional education is to give mathematics text problems [11]–[13]. Students are usually asked to read (or listen) a math story or problem, write down the mathematical operations required to complete an assignment, and then solve the problem. One way to classify mathematical text problems has been proposed by Jordan and Hanich. They have categorized word problems in mathematics into four types of items, each of which is determined by a problem solving strategy: comparing, converting, combining, and equating. This categorization will be used in this study. The skills required to process written information such as reading skills have been considered a combination of decoding and comprehension skills [14], [15].

Reading also aims at understanding what operates at two levels of a process. First, the reader understands the meaning of the sentence, and then, the reader applies previous knowledge and general knowledge to solve the problem at hand. Moreover, the reasoning strategies used by readers at various age levels have attracted researchers [16]–[18]. Lindeman has identified five different types of reading comprehension questions in the PISA reading test, there are five categories of question types: cause-and-effect / structure, concept / phrase, conclusion / interpretation, main idea / objective, and detail / fact. There are good reasons to assume that the logical reasoning pattern behind reading differs according to the comprehension question type [19], [20].

Additionally, math ability has been found to be linked to technical reading skills. For example, Marzolla and Munn said that the numeracy ability of kindergarten age children can be predicted through text reading skills, word chain reading skills, and reading comprehension of fourth grade students [19]–[22]. The results showed a covariance between difficulties in arithmetic and phonological-based problems in reading. The relationship between reading and numeracy skills was also strengthened by data on reading and math skills ratings that did not differ greatly in each country [23]–[25]. Relying on these previous findings, the researchers focused on reading and math skills in children who were in schools with different clusters. Each school sets different criteria for students who wish to attend the school, of course these criteria cannot be separated from the student's academic ability and the financial ability of the student's family.

In this study, the relationship between math word problem solving skills and text reading comprehension skills will be examined first. The next focus is whether the children in the upper cluster schools are better in terms of reading and numeracy skills, and how the correlation between these two abilities in children who are in school with the upper, middle, and lower cluster. It is hoped that the finding of the correlation between children's reading and numeracy skills in each of these clusters can be used as a way to provide learning to read and count for different children in each school so that learning becomes effective.

2. Method
This study uses a correlational method with the aim of seeing the correlation between reading comprehension ability and ability to solve mathematical problems [12]. The data source is the results of tests on the ability to read mathematics texts and the numeracy ability of elementary students in one of the regions of Bandung, Indonesia, with a sample of 3 schools each in the top (A), middle (B), and lower (C) clusters. Participation in this study were 300 people with 100 clusters represented by each student. The school sample represents three categories, namely schools with poor (C), good (B), and very good (A) accreditation. The research instrument consisted of two sets of tests, namely the ability to read math word problems and numeracy tests. Both of these test sets use the same text stimulus, which is mathematical text that is presented verbally. The reading test focuses on questions of understanding and interpretation of reading content related to mathematical operations (addition, subtraction, multiplication, and division); while the numeracy skills test is focused on solving numeracy problems which are presented in the form of numbers.
3. Result and Discussion

The essence of reading is to understand the contents and messages of reading. Reading activities is that not only recognize printed symbols, but also meanings and interpretation of printed symbols. Code / symbol interpretation refers to the split of the symbol code, while understanding refers to the meaning of the message [12], [26], [27]. Failure to reap the meaning of printed symbols in understanding mathematical texts causes failure to interpret the basic mathematical calculation operation procedures. When the process of basic mathematical operations must be completed through numeration, as added, subtracted, multiplied, or divided, it will be largely determined by one's understanding of the verbal text. It is clear that students who are fluent in reading comprehension (mathematics texts) show good ability in solving their mathematical problems [7], [27]. Reading activities enable people to get meaning from texts [16], [17].

Achievement of the average numeracy ability based on the categories of schools accredited C, B and A each shows an average value of numeracy ability 41, 43.5, and 55.3. The gap between the average scores in reading mathematics texts and the average numeracy ability for each school category is as follows. For schools categorized as C is 2.5 (41-38.5). In schools with category C, the average value of numeracy skills is better than the ability to read mathematics texts. The gap in schools with category B is 1.7 (43.5 - 41.8). In school B category, the average value of the ability to read mathematics texts is better than the average ability to count. The gap in school with category A is 0.8 (55.3 - 49.5). In school category A, show the opposite. The average value of numeracy ability is better than the average value of the ability to read mathematical texts. Correlation test results show a positive correlation between the ability to read mathematical texts and the ability to count. Significant correlations were shown by schools categorized as C (0.76) and category B (0.79); while schools with category a show a low correlation result (0.45). The average value of the ability to read mathematical texts, the average ability to count, and correlation, both per school category and overall can be seen in table 1 below.

Table 1. Average reading, numeracy, and correlation values

| School’s categories | Reading Competencies Mean | Mode | Median | Counting Competence Mean | Mode | Median | Correlation Value |
|---------------------|---------------------------|------|--------|--------------------------|------|--------|-------------------|
| C                   | 38.5                      | 35   | 30     | 41                       | 60   | 40     | 0.76              |
| B                   | 41.8                      | 35   | 50     | 43.5                     | 41   | 41     | 0.79              |
| A                   | 54.5                      | 50   | 50     | 55.3                     | 51   | 50     | 0.45              |

The correlation of mathematical texts and numeracy skills for each school category can be seen in Figures 1, 2, and 3. The graph shows evidence of a strong relationship between the two variables studied. The graph that proves a strong relationship between the ability to read mathematical texts and numeracy skills in school C can be seen in figure 1 below. Reading competence is parallel with the scores obtained by students on numeracy competencies. This is reinforced by the value of r or the correlation between reading competency and numeracy in school which is categorized as C, which is 0.76.

Figure 1. Score of Reading Ability and Counting Ability Students in Categorized Schools C
The graph that proves a strong relationship between the ability to read mathematical texts and the ability to count in school B can be seen in figure 2 below. Reading competencies in the same direction as the scores obtained by students on numeracy competencies. This is reinforced by the value of r or the correlation between reading and numeracy competencies in school B that is equal to 0.79.

![Figure 2](image_url)

**Figure 2.** Score of Reading Ability and Counting Ability Students in Categorized Schools B

Evidence of the opposite occurs in schools that are categorized A. The average score of the numeracy ability of students in schools that are categorized A is better than the average score of the ability to read mathematics texts. Meanwhile, the correlation rate is not very strong (0.45). Children who have relatively high intelligence tend to be more talented in the right fields, including matters of counting. Numerical questions presented in the form of numbers will be more interesting for them, than presented in the form of verbal texts. The reluctance to read verbal texts that are influenced by interest will have an impact on inaccurate interpretation of content and text messages [28]–[30].

Some respondents pointed out a parallel between the results of a mathematics text reading test and numeracy skills. However, several other respondents indicated the opposite. Good or bad numeracy skills are not followed by good or bad text reading skills. The complete picture can be seen in Figure 3.

![Figure 3](image_url)

**Figure 3.** Score of Reading Ability and Counting Ability Students in Categorized Schools A
From these three data, the researcher can conclude that reading and numeracy competence does have a positive correlation. Code interpretation refers to the breakdown of code symbols, while understanding refers to the idea of messages [9], [10], [25]. It must be realized that the most important thing in the reading process is understanding. However, understanding will not occur if the reader does not recognize the symbol code (letters). It is clear that students who have good ability to understand reading or text on mathematical problems will master more ways of solving mathematical problems compared to students who are less able to understand texts. This is evidenced by students whose high reading skills have implications for high numeracy skills. In schools with cluster A there is a significant relationship between reading and numeracy skills. This indicates that the better competency in reading and calculating the correlation abilities of the two competencies is not too strong because the ability of students in the two competencies is evenly distributed. In contrast to students who are in the lower cluster schools (B, and C) the ability to read and count is not evenly distributed so their ability to solve mathematical word problems is very dependent on reading competence [15], [21], [22].

4. Conclusion

Literacy and numeracy competencies are two competencies that have a strong relationship. Students can solve basic mathematical problems (numeracy) based on mathematical word problems (verbal and narrative) if students have good reading comprehension competencies. Thus, reading competence will be the main foundation in the construction of education and teaching in schools. Reading activities are part of literacy activities. Literacy education becomes an urgent matter to be instilled in schools, both through the learning process or the habituation process. In schools with cluster A there is a significant relationship between reading and arithmetic skills. This indicates that the better competency in reading and calculating the correlation abilities of the two competencies is not too strong because the ability of students in the two competencies is evenly distributed. In contrast to students who are in the lower cluster schools (B, and C) the ability to read and count is not evenly distributed so their ability to solve mathematical word problems is very dependent on reading competence. Learning to read and learn mathematics in the lower classes must be done integrative, not disaggregated. Separation of self-discipline can be done in secondary school or the next level.

5. References

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