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The Analysis of Language Use in Math Story Problems in Mid and Final Semester Assessment Manuscript

Lina Siti Nurwahidah

Indonesian Language and Literature Education, Institut Pendidikan Indonesia
Jalan Pahlawan No. 32, Sukagalih, Garut, Jawa Barat, Indonesia
linasitinurwahidah@gmail.com

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Abstrak

Soal cerita matematika merupakan bentuk soal yang melatih pemahaman berhitung dan membaca. Evaluasi akan menjadi tidak efektif jika penggunaan bahasa dalam soal cerita matematika kurang baik. Tujuan penelitian ini untuk mendapatkan gambaran tentang penggunaan bahasa dalam soal cerita pada naskah Penilaian Akhir Semester (PAS) dan Penilaian Tengah Semester (PTS) mata pelajaran Matematika. Penelitian ini menggunakan pendekatan kualitatif dengan metode deskriptif analitik. Sumber data didapatkan dari naskah soal PAS dan PTS Matematika yang digunakan oleh sekolah dasar di Garut. Jumlah seluruh naskah ada 36 naskah dengan jumlah butir soal yang merentang dari tahun pelajaran 2017-2018 sampai 2022-2023 sebanyak 1020 soal. Penganalisisan dilakukan pada soal cerita yang tersebar pada lima tipe jenis soal, yakni soal pilihan ganda, soal pilihan ganda analisis kasus, betul-salah, menjodohkan, dan soal uraian. Hasil analisis data menyimpulkan bahwa terdapat ketidaktepatan dalam penggunaan bahasa soal cerita matematika dengan persentase yang variatif. Untuk ketidakgramatikalan berjumlah 31 persen, ketidaktepatan diksi 25 persen, ketidakhematan 15 persen, ketidakparalelan 6 persen, dan ketidaklogisan 22 persen.
Kata Kunci: PAS; penggunaan Bahasa; PTS; soal cerita.

Abstract

Math story problems are a form of problem that trains counting and reading comprehension. The evaluation will be ineffective if the use of language in the math story problems is flawed. This study aimed to get an overview of the use of language in the Math story problems in Final and Mid Semester Assessment manuscripts. This study used a qualitative approach with an analytic descriptive method. The data was obtained from the mathematics assessment question texts used by elementary schools in Garut, with 36 manuscripts comprising 1020 questions spanning from 2017-2018 to 2022-2023 academic years. The analysis was carried out on the language problems in the story problems question types used in the multiple choices, case analysis multiple choices, true-false, matching, and essay questions. Based on the analysis, there were inaccuracies in the use of the language with varying percentages. Thirty-one percent of the data are ungrammatical, 25 percent use incorrect diction, 15 percent are ineffective, 6 percent are non-parallel, and 22 percent are illogical.
Keywords: final semester assessment; language use; Math story problems; mid semester assessment.

I. INTRODUCTION

Language is considered the most critical aspect of communication and conveying thoughts. Language is divided into two huge categories: spoken and written. Each type has a different mode of communication. The category of written language is considered complicated because it must include various language rules (Widjono 2007; Puspita, Muzdalipah, & Nurhayati, 2023). In contrast, ideas can be conveyed directly in spoken language using the not-too-meticulous rules of spoken language (Parera, 2008). For written language, apart from preparing statements, the space for expressing them should also be considered (Dhanawaty, 2017). Moreover, different writing media also have different types of writing and rules.

Every written language user has to pay attention to written media, such as exam scripts. Using written texts to generate exam questions is expected in the school environment. They are commonly used to evaluate the teaching and learning process at every level of schooling (Fitriah et al., 2021). This kind of text is used in language subjects and all taught at school – including Math. In Math, these kinds of questions are called story problems (Al-Qonuni & Afriansyah, 2023).

Math story problems are a form of problem that trains counting and reading comprehension (Dianti et al., 2022; Pongsakdi et al., 2020). This type of question aligns with the 2013 curriculum, which demands that all questions include problem-solving skills. This will pose some problems to the students if the math story problem makers cannot utilize the language well (Erath et al., 2021; Rohid et al., 2019; Setiyani et al., 2020). The evaluation will be ineffective if the use of language in the math story problems is flawed (Ardani & Nurkhalfidhoh, 2021). Thus, the goals of learning mathematics cannot be achieved entirely because students may have difficulties comprehending the exam questions (Maulyda et al., 2019; Soneira et al., 2023; Wakhata et al., 2022). They might be aware of the mathematical concept (Vicente et al., 2022), but if the language used in the story problems is ineffective, they might fail to answer the questions (Rodríguez-Martínez et al., 2020).

Effective sentences are designed to produce a more informative structure so that the sentence is more communicative (Aziez, 2008; Suladi, 2019; Rahardi, 2020; Wiyanto, 2006). An effective sentence structure must meet these criteria: congruence, parallelism, firmness, and efficiency (Juhara, 2005). Congruence can be defined as the logical and reasonable arrangement of language. Parallelism is the design of the language used for a particular compelling purpose. Firmness is related to the resolve to state the main ideas. Efficiency is associated with diction (Keraf, 2007; Mustakim, 2019) and language choice in constructing sentences. Thus, effective sentences have a coherent

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arrangement, and there is no waste of words or ambiguous words (Wibowo, 2001; Widjono, 2007).

Meanwhile, according to Soedjito (2007), a sentence is said to be effective if it meets the following requirements: (1) grammatical; (2) accurate; (3) reasonable; and (4) contextual. Grammatical, in this case, is following grammar rules. Accurate refers to the accuracy of word choice, which is determined by several things, including the use of accurate standard, synonymous, foreign, concrete, abstract, general, and specific words, and idioms. Reasoning in making sentences is needed so that sentences are easily understood and not ambiguous. Contextual is the emphasis on the use of language following the situation and conditions.

Research on the use of sentences was carried out by Maruka (2018). She focused her study on the sentences used in posters. The study stated several characteristics of the effectiveness of sentences on signs. They should be (1) congruent, (2) logical, (3) parallel, (4) firm, (5) efficient, (6) coherent, and (7) cohesive. The characteristics that appear most from the study are coherent and firm. Another research on this topic was conducted by Ramadhanti (2015). The study found that ambiguity and redundancy often happened in the student's scientific writing. In addition to Ramadhanti's research, Riswati (2015) conducted similar research. Her research revealed that most errors occurred in the use of sentences, and the least was in the illogicality of the sentences.

Subsequent research was conducted by Widyanto (2017) on the relationship between reading comprehension and the ability to solve math story problems at the elementary level. The study results showed a positive and significant effect of reading comprehension ability on the ability to solve math story problems. Similar research by Wijarani (2016) showed that the higher the reading comprehension ability, the higher the achievement in solving math story problems at the secondary level.

Moreover, research conducted by Marzuqi (2016) on secondary-level math story problem writing showed that the question makers still made mistakes. The study results indicated that sentences with poor diction were incomplete, inefficient, not parallel, and illogical.

Even though numerous experts have conducted similar research topics, this study has a different focus and object of discussion. This study focused on analyzing the use of language, especially on the use of sentences contained in Math story problems in the Final and Mid Semester Assessment questions. The results of this study can be used as a reference for practitioners in composing Math story problems in terms of the use of sentences to increase their understandability.

This study is expected to enrich the knowledge of relevant theory and practically support teachers and students

in teaching and learning Math story problem-type questions by focusing on this issue.

II. METHOD

The method used was the descriptive qualitative method (Hardani, 2020). The descriptive research method is based on the post-positivism philosophy, usually used under natural objective conditions where the researcher acts as the key instrument. (Sugiyono, 2022). Data collection techniques used documents and interviews (Syamsuddin, Vismaia, 2010). The necessary documents were collected from the Math word problems questions. The data sources were the Final and Middle Semester Assessments of Math subjects ranging from 2017-2018 to 2022-2023 academic year of the elementary school level in Garut Regency. Meanwhile, interview data were obtained from several teachers from Tarogong Kidul, Pangatikan, and Cikajang districts. In addition, it was also obtained from the elementary school-level supervisor.

Mathematics questions for elementary school are presented in two types: story problems and non-story problems with five varieties: multiple choices, case analysis, multiple choices, true-false, matching, and essay types. The number of math story problems used in the analyzed Final and Mid Semester Assessment exams transcripts was 36 scripts, with the following details in Table 1.

Table 1.
Recapitulation of Final and Mid Semester Assessment Manuscripts

Grade	Mid Semester Assessment						Final Semester Assessment					
	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022
IV	20	20	20	20	20	25	45	35	30	35	35	35
V	20	20	20	20	20	25	45	35	30	35	35	35
VI	20	20	20	20	20	25	45	35	30	35	35	35
Sub-Total	60	60	60	60	60	75	135	105	90	105	105	105
Total	1020											

After the data is obtained, it is classified, analyzed, and concluded. The analysis of the data is intended to look at the grammar, diction, efficiency, parallelism, and logic in each sentence of story problems. Besides that, the researcher also provides arguments on the math story problems, which are the object of the study. Figure 1 illustrates the data analysis

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flow, as adapted from Miles and Hubermann (1992).

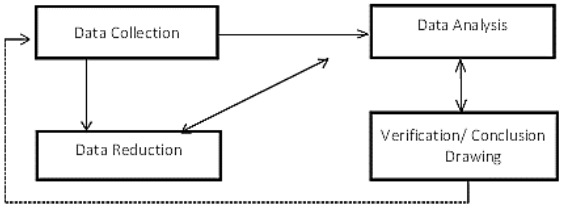

Figure 1. Data Analysis Flow

III. RESULT AND DISCUSSION

A. Result

For the elementary level, math word problems are presented in story and non-story. The number of math questions used for the Mid and Final exams at the elementary level in Garut Regency from 2017/2018 to 2022/2023 academic year is 1020 questions. There are 421 story problems, while the other questions are in the form of non-story problems. Table 2 until Table 4 recapitulates the number of story problems on several questions in the Mid and Final texts used at the elementary school level in Garut Regency.

Table 2.
Grade 4 Question Types Recapitulation

Academic Year	Mid Semester Question Types					Final Semester Question Types				
	Multiple Choice	Case Analysis MC	True-False	Matching	Essay	Multiple Choice	Case Analysis MC	True-False	Matching	Essay
2017	4	3	-	-	-	4	3	-	-	-
2018	4	3	-	-	-	4	3	-	-	-
2019	4	3	-	-	-	4	4	3	3	-
2020	4	3	-	-	-	5	5	5	5	-
2021	5	5	-	5	5	5	5	5	5	-
2022	4	6	1	-	-	7	3	2	4	-

From the table, it could be seen that from the range of 2017-2022, all grade 4 question types are covered in the form of story problems. There are differences in question types of the mid and final-semester manuscript. Unlike in the final semester, that story problem almost covers all question types, in mid-semester cases, the math story problem is commonly used in multiple choice and case analysis multiple choice questions only. However, it could also be perceived that the story problem type is not widely used in essay questions.

Table 3.
Grade 5 Question Types Recapitulation

	Mid Semester Question Types	Final Semester Question Types

Academic Year	Multiple Choice	Case Analysis MC	True-False	Matching	Essay	Multiple Choice	Case Analysis MC	True-False	Matching	Essay
2017	3	3	1	-	-	5	4	5	-	-
2018	4	2	-	-	-	-	-	-	-	-
2019	4	2	2	-	-	3	3	1	3	-
2020	3	2	2	-	-	-	-	-	-	-
2021	3	2	4	4	8	5	5	5	5	5
2022	2	3	1	3	-	9	4	-	-	3

From the data above, from the range of 2017-2022, all grade 5 question types are covered in the form of story problems. Unlike the grade 4 ones, the story problem type is commonly found in the true-false questions in addition to multiple choice and case analysis multiple choice. However, it could still be seen that the story problem type is not commonly used in essay questions.

Table 4.

Grade 6 Question Types Recapitulation

Academic Year	Mid Semester Question Types					Final Semester Question Types				
	Multiple Choice	Case Analysis MC	True-False	Matching	Essay	Multiple Choice	Case Analysis MC	True-False	Matching	Essay
2017	3	3	3	4	-	3	3	-	3	3
2018	4	3	4	4	-	3	2	-	3	4
2019	3	3	5	3	-	4	3	-	4	4
2020	4	4	4	4	-	3	6	-	4	5
2021	4	3	5	5	4	4	3	-	4	-
2022	1	4	2	3	-	5	3	2	4	-

As for grade 6 questions, the math story problem types are almost equally spread in the questions. It is also commonly found in matching, essay questions, and other types. Especially for essay questions, the math story problem is frequently seen in the final semester questions only.

Below, the samples of analysis of the language used in Math story problems are presented.

1. Grade 4 Assessment Manuscript

a. Data 1

Sari membeli satu potong pakaian atas dengan harga sebelum diskon dan satu potong celana Rp 80.000,00 dan satu potong celana dengan harga sebelum diskon Rp 120.000,00. Sari membayar pakaian atas dan celana dengan pecahan uang Rp 100.000,00 dan Rp 50.000,00 masing-masing satu lembar. Uang kembalian yang diterima Sari adalah …. (Question number 5)

1) Analysis

a) Grammar

The phrase "*satu potong pakaian atas dengan harga sebelum diskon dan satu potong celana*" in the first

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sentence is incorrect because it refers to only one piece of clothing.

b) Efficiency

In the story problems, there is unnecessary repetition, namely phrases "*dengan harga sebelum diskon*" and redundancies, namely "*dengan pecahan uang Rp 100.000,00 dan Rp 50.000,00 masing-masing satu lembar*".

2) Correction

Sari membeli satu potong pakaian atas dan satu potong celana dengan harga masing-masing (sebelum diskon) Rp80.000,00 dan Rp120.000,00. Sari membayar keduanya dengan uang Rp150.000,00. Uang kembalian yang diterima Sari adalah ….

b. Data 2

Jika semula Beni mendapat urutan kedua dan Beni bermain sebanyak 5 kali maka Beni bermain selanjutnya pada urutan 5, 8, 11, 14, 17. (Question number 6)

1) Analysis

a) Grammar

The sentence consists of two clauses, namely *"mereka berbaris ke belakang"* and *"tepukan mulai dari anak nomr urut 5".* The separation between clauses can be done in two ways, namely (1) using a conjunction or (2) using a semicolon (;).

2) Correction

Jika semula Beni mendapat urutan kedua dan bermain sebanyak 5 kali, maka Beni bermain selanjutnya pada urutan 5, 8, 11, 14, 17.

c. Data 3

Mereka berbaris ke belakang, tepukan dimulai dari anak nomor urut 5. (Question number 7)

1) Analysis

a) Grammar

The sentence consists of two clauses, namely *"mereka berbaris ke belakang"* and *"tepukan mulai dari anak nomr urut 5".* Separation between clauses can be done in two ways, namely (1) using a conjunction, or (2) using a semicolon (;).

2) Correction

a) *Mereka berbaris ke belakang dan tepukan dimulai dari anak nomor urut 5*.

b) *Mereka berbaris ke belakang; tepukan dimulai dari anak nomor urut 5*.

d. Data 4

… dan akan dimasukan ke dalam plastik. (Question number 9)

1) Analysis

a) Diction

The word *"dimasukkan"* is categorized as a verb. The word is formed from *"di-", "masuk",* and *"-kan".* Therefore, the correct spelling is *"dimasukkan."*

2) Recommendation

… dan akan dimasukkan ke dalam plastik.

e. Data 5

Guru Kelas IV SD Bunga Bangsa mendata pekerjaan orang tua siswa. Hasil pendataan diperoleh sebanyak 40% bekerja sebagai bertani, sebanyak 0,15 orang tua siswa sebagai TNI/POLRI dan

PNS, sebanyak ¼ orang tua siswa sebagai buruh, dan sisanya sebagai pedagang. (Question number 16)

1) Analysis

a) Grammar

This sentence is not practical because it does not use substitution. The phrase *"Hasil pendataan diperoleh …"* should be replaced with *"Hasilnya adalah sebagai berikut."*

b) Parallelism

The word "*Bertani*" is categorized as a verb. Meanwhile, the words "*TNI/POLRI*," "*PNS*," "*buruh*", and "*pedagang*" are nouns. Thus, the details of the work are not parallel. The word "*bertani"* should be changed to "*petani*."

c) Efficiency

The repetition of the phrase "*orang tua siswa sebagai …* "makes the sentence inefficient. It is better to remove this phrase.

2) Correction

Guru Kelas IV SD Bunga Bangsa mendata pekerjaan orang tua siswa. Hasilnya adalah sebagai berikut. Sebanyak 40% bekerja sebagai petani, 0,15 TNI/POLRI dan PNS, ¼-nya buruh, dan sisanya pedagang.

2. Grade 5 Assessment Manuscript

a. Data 1

Amir diminta gurunya untuk menjumlahkan pecahan sesuai gambar di samping ini!

Jika pecahan yang dinyatakan dengan gambar dijumlahkan, maka hasil penjumlahan adalah ….(Question number 1)

1) Analysis

a) Grammar

First, using exclamation marks (!) is incorrect because they are not exclamatory but news sentences. Second, the word "*sesuai*" must be combined with the word "*dengan*." Third, the clause "*maka hasil penjumlahan…*" should be enough with the pronoun "*-nya*" as an anaphoric reference to the phrase "*pecahan yang dinyatakan dengan gambar*".

b) Efficiency

The conjunction *"untuk"* in the sentence *"Amir was asked by his teacher to add up ..."* is a waste.

2) *Correction*

Amir diminta gurunya menjumlahkan pecahan sesuai dengan gambar di samping ini.

Jika pecahan yang dinyatakan dengan gambar dijumlahkan, maka hasilnya adalah….

Data 2

Untuk membuat dua celana panjang dan dua kemeja lengan panjang penjahit tersebut memerlukan kain …. (Question number 4)

3) Analysis

a) Grammar

The sentence above is a multilevel complex sentence preceded by a dpendent clause, "*untuk membuat dua celana panjang dan dua kemeja lengan Panjang."* If the dependent clause precedes the

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independent clause, a comma (,) must be inserted between them.

4) Correction

Untuk membuat dua celana panjang dan dua kemeja lengan panjang, penjahit tersebut memerlukan kain ….

b. Data 3

Ibu akan membuat 12 adonan keju ambon, Susu bubuk yang diperlukan Ibu adalah 0,22 kg. (Question number 11)

1) Analysis

a) Grammar

The statement above consists of two news sentences (declarative). Both of them should be ended by a full stop (.). Second, the phrase "*yang diperlukan Ibu"* should be changed to "*yang Ibu perlukan".*

2) Correction

Ibu akan membuat 12 adonan keju ambon. Susu bubuk yang Ibu perlukan adalah 0,22 kg.

c. Data 4

Ibu menimbang tepung terigu, tepung maizena dan margarin sekaligus …. (Question number 12)

1) Analysis

a) Grammar

If there are more than two types of details, using a comma (,) before the conjunction "*dan*" is necessary.

2) Correction

Ibu menimbang tepung terigu, tepung maizena, dan margarin sekaligus ….

d. Data 5

Biaya untuk membeli telur dan susu bubuk setiap adonan 20% dari seluruh bahan untuk setiap adonan, jika untuk satu adonan ibu membayar …. (Question number 14)

1) Analysis

a) Grammar

The first sentence of the statement above ends with the word "*adonan"*. Therefore, it must end with a full stop (.) instead of a comma (,). Second, the term "*jika*" must begin with a capital letter because it is the beginning of a sentence.

b) Efficiency

The repetition of the phrase "*setiap adonan"* in the above sentence is unnecessary.

2) Correction

Biaya untuk membeli telur dan susu bubuk setiap adonan 20% dari seluruh bahan. Jika untuk satu adonan ibu membayar ….

3. Grade 6 Assessment Manuscript

a. Data 1

Suhu udara di puncak Gunung Everest pada pukul 05.00 adalah -26 oC Setelah matahari terbit, …. (Question number 11)

1) Analysis

a) Grammar

The first sentence should end with a period (.).

2) Correction

Suhu udara di puncak Gunung Everest pada pukul 05.00 adalah -26 oC. Setelah matahari terbit, ….

b. Data 2

Jika adik akan membuat ¼ nya dan kakak membuat 2/5 nya dari resep tersebut …. (Question number 27)

1) Analysis

a) Grammar

Writing the third person singular pronoun "-*nya*" as an enclitic should be combined with the word that precedes it, not separated. If the previous word is a number or a foreign term, a hyphen (-) is added before the enclitic "-*nya*" to indicate that the enclitic word is not separated.

2) Correction

Jika adik akan membuat ¼-nya dan kakak membuat 2/5-nya dari resep tersebut ….

From the examples of the analysis of the Math story problems in the Mid and Final Semester Assessment manuscripts for grades IV, V, and VI, the following data in Table 5 could be presented.

Table 5.

The Recapitulation of Language Use Analysis from Mid and Final Semester Manuscripts from 2017-2018 to 2022-2023 Academic Year

No.	Grade	Language Use Aspects				
		Grammar	Diction	Efficiency	Parallelism	Logic
1	IV	75	38	24	9	42
2	V	41	58	34	10	29
3	VI	37	25	15	12	37
	Total	153	121	73	31	108
	Percentage	31 %	25 %	15 %	6 %	22 %

B. Discussion

Based on the results of the analysis of math story problems, the writer gets a picture that the failure of students' understanding of the story problems is caused by ineffective language. This occurs in several indicators: ungrammatical, inaccurate diction, and illogical. The results are in a relatively large percentage.

Math story problems are presented using language that uses lots of symbols and notations. How the issues and solutions are delivered also uses mathematical mindsets or concepts. This distinguishes it from non-story problems, which are delivered directly in mathematical symbols and notations. Thus, the use of language can cause the students difficulty in solving story problems (Wakhata et al., 2022). This is in line with Syakur et al. (2021), who found that one of the causes of errors in solving story problems was that students had difficulty translating the language used in the questions into arithmetic notations. This translation error ranked second out of eight types of errors, namely after strategy errors in her study. (Suryanto, 2001) also identified that one of the causes of students' failure in learning mathematics is related to the problems of understanding the questions. A study by Royani (2008) also concluded that language use is the dominant factor that causes a similar situation. This is indicated by a very significant correlation between language

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skills and the ability to solve story problems.

The stated difficulty makes mathematical communication skills important (Dianti et al., 2022; Pongsakdi et al., 2020). This skill conveys mathematical ideas both orally and written (Maulyda et al., 2019). Students' mathematical communication skills can be developed through the learning process at school, one of which is the process of learning Math. One of the elements of mathematics is logical thinking, which can develop students' thinking skills. Thus, Math subject has an essential role in developing mathematical communication skills. Because of the importance of this skill, an educator must first understand mathematical communication and know how to teach it (Erath et al., 2021; Rohid et al., 2019; Setiyani et al., 2020). These must be done to develop the student's mathematical communication skill sets.

According to Baroody (in Kadir, 2008), there are two essential reasons why communication should be one of the focuses in learning Mathematics. First, Mathematics is a language for mathematics itself. Mathematics is a thinking tool that helps us find patterns, solve problems and draw conclusions, and communicate our thoughts about various ideas so that they are clear, precise, and concise (Maulyda et al., 2019). Not only that, mathematics is also considered a universal language with many unique symbols and notations. Everyone can use it to communicate mathematical information even if their native language differs. Second, learning and teaching mathematics is a social activity involving at least two parties: teachers and students. In the learning and teaching process, conveying thoughts and ideas to each other through language is very important. This exchange of experiences and ideas is a process of teaching and learning. Indeed, communicating with peers and teachers is very important to develop communication skills – including mathematical communication skills – so they can learn to think and solve problems. Through the general and mathematical communication process, students can exchange ideas, discuss, share opinions, and at the same time, clarify the understanding and knowledge they gain in Math learning.

IV. CONCLUSION

The analysis results revealed that the use of language in many math story problems does not follow Indonesian grammar rules. Grammatical (31%) inaccuracies are the most prevalent mistakes among others. Then it is followed by diction mistakes (25%), logical faults (22%), inefficiency (15%), and non-parallelism (6 percent). From these results, we can conclude that many of the sentences used in math problems are ungrammatical. This has an impact on reasoning/logic. Not only that, but many word-choice inaccuracies also affect the reasoning. Moreover, based on the results

of interviews with teachers and supervisors, it is discovered that most teachers do not have an Indonesian language education background. Therefore, they teach and evaluate math subjects without considering the use of language. These large numbers of inaccuracies in the use of language in the Math story problems composed by the school in the Mid Semester Assessment script and by the Garut Education Officials in the Final Exam Assessment script show that the question makers still have to learn to use effective written language. Thus, a clear picture of the question writers who ignore the rules for utilizing correct and effective speech can be revealed. Thus, the authors provide several recommendations to related parties, including (1) conducting training for question-making for both teachers at school and education officials' regency levels in the procedure for composing story problems questions; (2) carrying out seminars on the awareness of written language use, especially on the use of spelling, dictionary and Indonesian grammar.

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AUTHOR'S BIOGRAPHY

Dr. Lina Siti Nurwahidah, M.Pd.

Born in Garut, May 27th, 1968. Lecturer at the Indonesian Institute of Education, IPI Garut. Graduated in 1992 from Indonesian Language and Literature Education Study Program Bachelor's degree at Universitas Pendidikan Indonesia, Bandung; graduated in 2004 from Indonesian Language and Literature Education Study Program Master's degree, at Universitas Pendidikan Indonesia, Bandung; and graduated in 2014 from Indonesian Language and Literature Education Study Program Doctoral degree, at Universitas Pendidikan Indonesia, Bandung.