Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.5, No.12, 2014

The Types of Word Problem Discourse Structure in Mathematics Textbook Presented In Indonesian For Primary School Students

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ABSTRACT

Word problem is a type of mathematical problem delivered with a language as its platform, so that this factor does contribute to the ease level of the problem to be understood by students, including the discourse structure factors. Since textbooks are widely used in classroom as a source of mathematical learning, it is necessary to study them adequately in developing such a skill. This study aims at identifying the types of discourse structure of the word problem in the mathematics textbooks presented in Indonesian which is viewed from the number of components and the type of the integration of those components. There are three components in the word problems. They are initial situation, event, and question component. Nine mathematics textbooks of 4th, 5th, and 6th grades were taken as samples with three books for each grade. There are 1,252 word problems found from those books. The study result about the number of components composing word problems also shows that 65% of word problems for fourth grade, 79% of word problems for fifth grade, and 88% of word problems for sixth grade consist of the three components. The others are word problems with only two components by omitting the first component which is the initial situation component. Viewed from the components integration type, the result of the research shows that word problems components combined for the fourth grade are the initial situation and events components while for the fifth and sixth grades are the events and question components. The integration between initial situation component and event component is indicated by the conjunction word *dan* 'and', *sedangkan* 'while/whereas', and a comma. The integration between the event and question components is indicated by the conjunction word *jika* 'if'. The conclusion of this study is that, viewed from their discourse structure, most word problems for the fourth grade students are relatively shorter than those for the fifth sixth students, by omitting the initial situation component. It implies that there is not any introduction part to introduce the context or narrative elements whose function is to connect the real world and mathematics.

Keywords: *Word problem, mathematics textbook, structure of math discourse, initial situation component, event component, question component*

INTRODUCTION

For students in Indonesia' primary schools, word problems are harder to solve than the common problems. It could be related with many research results which show that there are more calculation mistakes in solving the word problems than common problems (Desfitri, 2004; Roebiyanto & Harmini, 2003). A work problem is defined as language that contains many symbols and notations used to elaborate a problem and its solution by using thinking pattern and mathematics concept. This is the one that distinguishes a word problem from common problems whose delivery is direct by using mathematics symbols.

As a form of discourse, word problems possess genre that is different among other types of discourse. In that discourse, there are not only linguistic symbols, but also mathematics symbols. Therefore, Sarukkai (2001) says that word problem is a discourse with non-linguistic symbols so that it is categorized as a unique kind of discourse. Mathematics symbol is contained in all of it three components that covers initial situation, event, and question As a normal text, initial situation component has the same function as opening part, event component functions as content, and question component Works like a closing. /How these three components could be identified is shown below.

Ibu Ema membuat sebuah kue yang cukup besar. Kue itu dipotong-potong menjadi 16 bagian yang sama besar 'Madam Ema bakes a big cake. That cake is sliced into 16 pieces uniformly'.(**initial situation component**) *Pulang dari sekolah, Ema dan adiknya makan 4 potong* 'Coming back from school, Ema and her sisters eat 4 pieces.' (**event component**). *Berapa potong kue yang tersisa?* 'How many pieces of cake left?' (**question component**)

Ideally, a word problem contains all those three components with linear order. However, according to research result by Abedi & Lord (2001) and Gerofsky (1996), half of the word problems found in mathematics textbooks do not fulfill these criteria. On the other hand, the result of research done by Gerofsky (1996) shows that when students are asked to make a word problem, they will make it with ideal pattern, which contains all those three

component completely with a linear order. This is supported by research done by Ramirez (2008) which concludes that students from higher level of education consider that it is easier to make a mathematical equation from problems with this character. This shows that word problems in textbooks, especially those who are provided for primary school students are supposed to contain problems with complete components and linear order among those components. Therefore, this research's purpose is to identify the type of word problem discourse in mathematics textbooks for fourth, fifth, and sixth grade students in primary school according to (1) the number of components and (2) the discourse structure based on its components' position.

Word problem is form of problems in mathematics. Mathematics word problem is mathematics problem that is provided through a language as its medium, while the story that is used is related with daily life that requires mathematics to arrive at the solution (Roux, 2008:8). Therefore, basically word problem does not have any differences compared to non-word problems because it is a form of derivation from those problems with mathematics notation as claimed by Bairac (2008) and (Verschaffel, Greer, &, De Corte, 2003:3)

Structurally, word problems are constructed by three components, which are initial situation component, event, and question (Bairac, 2008:124). Initial situation component is an opening part that gives an introduction to the situation which in a word problem usually is located in the first or second sentence. Event component is an event that changes the situation that is usually located after the initial situation component. Question component is the sentence that is questioning the effect of the changes happened at the initial situation because of the presence of event that changes it. The position for each of those components in a word problem is shown in an example given by Bairac, as provided below:

1. *John is twenty years younger than Amy*.(**initial situation component**). *In five years' time he will be half her age*.(**event component**). *What is John's age now?* (**question component**)
2. *Jeffrey has saved $6.78*.(**initial situation component**) *The shiny toy airplane that he wants is $ 2.55*.**(initial situation component)** *If Jeffrey buys two toy airplanes,* **(event component)** *how much money will Jeffrey have left?* **(question component)**

Regarding the components in word problems, Gerofsky (1996:37) also agrees that both traditional paradigm and modern one support the idea that there are three components in the discourse structure, which are:

1) Initial situation component or opening, which is part of discourse that contains the introduction of characters, setting description, and problem construction.
2) Situation change component, which is the peak of the problem that includes important information needed to solve the problem.
3) Question component, which is part that questions the effect of the presence of information component.

The position of those three components could be seen in word problems made by student shown by Gerofsky (1996:38) as provided below:

> *One day Jerry left camp on his motorcycle to go to the village. Ten minute later Jake decided to go too*.**(initial situation component)** *Jerry was travelling 30 mph and Jake traveled 35 mph* **(situation change component).** *How long before Jake caught with Jerry?* **(question component)**

According to the explanation and examples provided by Bairac and Gerofsky above, it could be said that although the component naming is different, the idea of those two researchers have similarities. This covers both the number of components and the concept possessed by each. Thus, researcher uses the same component naming stated by Bairac and Gerofsky together because the naming convention given by Gerofsky for the first and second components, which are opening and situation change components, is relevant with the concept stated by Bairac. Therefore, from now on, the term word problem components include all those three components which are initial situation, event or situation change, and question.

There are sometimes variations in the problem construction, for example when the information component and question are combined together in an syntactical construction, which is by using a subordinate clause or by using subjunctive with *"If …..,so…..?"* structure like the modification result from the example above as shown below:

> *One day Jerry left camp on his motorcycle to go to the village. Ten minute later Jake decided to go too*.**(initial situation component)** *If Jerry was travelling 30 mph and Jake traveled 35 mph* **(event component),** *so how long before Jake caught with Jerry?* **(question component)**

In general, those three components are realized in a syntactical construction that is different, so that in a word problem discourse, there are minimum three syntactical constructions. However, teachers and word problems creators often do not consider the opening component as important. This component is often omitted because it is not considered as a part of the problem's mathematical equation. As an example, the word problem above is modified as shown below:

> *If Jerry was travelling 30 mph and Jake traveled 35 mph ten minute later* **(event component),** *how long before Jake caught with Jerry?* **(question component)**

Gerofsky (1996:41) finds that word problems whose components are combined together will produce a discourse construction which is either too long or semantically ambiguous. Therefore, it is important to put attention in the function of those three components in constructing word problem discourse. According to Verschaffel, Greer, & de Corte (2000), components in word problem has different function. Initial situation component gives a context while event component gives a hint related to the semantic structure (addition, subtraction, multiplication, division). Question component strengthen the semantic structure and the mathematical symbols used in the problem.

METHOD

The data sources in this research were mathematics textbooks used by the fourth, fifth, and sixth grade students. The interviews with primary school teachers show that there were three textbooks from three publishers widely used in Indonesia. All those three were textbooks selected by National Centre for Books, the Ministry of Education and Culture, known as 'Electronic Textbooks'.

The research data were the word problems found in the mathematics textbooks. The scopes were the mathematics problems provided through language as their medium, and there were at least two discourse components. Problems which did not fulfill those criteria were not included as research data. The word problems identified were categorized into two, problems with three discourse components and problems with two discourse components. The categorization was not seen from the number of the sentences, but from the functions in supporting the discourse structure. As an example, *Jika ayah bekerja selama 6 jam 45 menit, berarti berapa detik ayah bekerja?* 'If dad has been working hard for 6 hours 45 minutes, then how many seconds has dad been working?' was a word problem consisting of a sentence, but from its function in the passage, it contained two discourse components, which were "If dad has been working for 6 hours 45 minutes" as an event component and "how many seconds has dad been working?" as question component. Besides that, the analysis on discourse was also pointed to the word problem type according to the position of each of all its components, which according to the identification result was segmented into 6 types as listed below.

1. TYPE I: There are 3 separated components with linear order, which are constructed by initial situation component, event component, and question component.
2. TYPE II: There are 3 components, but the initial situation component is combined with event component by using conjunction words *and, while,* or comma.
3. TYPE II: There are 3 components with its event component and question combined by using conjunction *if* or comma.
4. TYPE IV: There are 2 separated components that cover event component and question component with linear order
5. TYPE V : There are two components that are combined using conjunction *if*
6. TYPE VI: There are three or two components but their position is not linear.

RESULT

Distribution of Word Problem Discourse in Mathematics Textbooks

The data sources for this research are mathematics textbooks that are widely used by the fourth, fifth, and sixth grade students of primary schools. There are three textbooks that are published by different publishers for each grade. Mathematics books composition is divided into several topics, each with its own theme. The material for each topic covers: (1) the explanation of the material together with its examples and (2) problem exercises. In every textbook, there are non-word problems, which are problems provided in mathematical notations, and word problems, which are problems provided in the form of story discourse. However, there are also problems that could not be categorized. This is for example "2 hours is ….. minutes" or "1 ream of papers is ….. sheets". Other examples are "The simplest form of fraction 25/35 is …." and "fraction with the same value as 4/5 = 16/ …". Since the scope of word problems is mathematics problems that is delivered through

language and story as its medium, these kinds of problems do not fulfill it. Because they do not fulfill the criteria, these kinds of problems are not classified as word problems. There are 1,252 word problems whose distribution could be seen at figure 1.

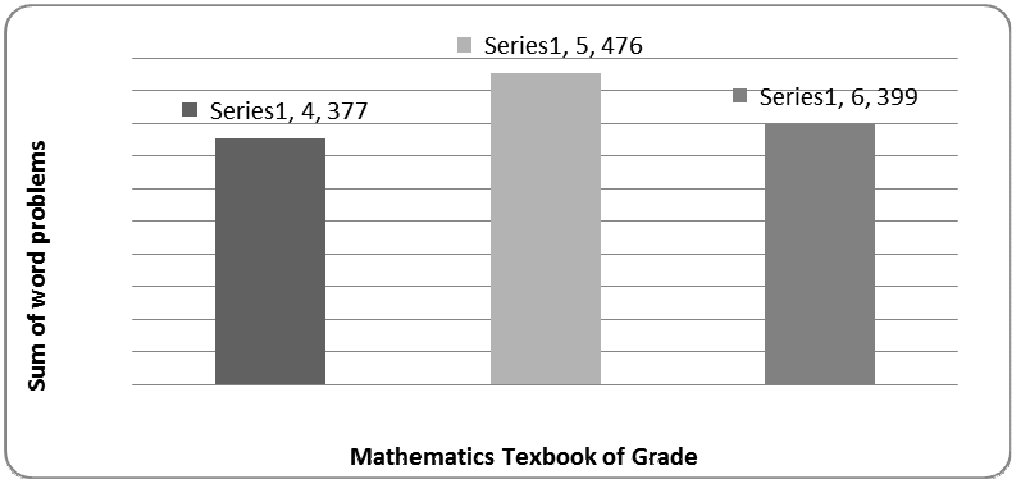

Figure 1: Word Problem Distribution in Textbooks

There are 377 word problems in three mathematics textbooks for students from the fourth grade or 30% out of the total number of word problems. There are 476 word problems for three mathematics textbooks for the fifth grade students or 38% from total, while for the sixth grade students; there are 399 word problems or 32%. Thus, the number of word problems for the fourth students is smaller than that of word problems for the fifth and sixth grade students. While for the fifth grade students, the number of word problems is the largest.

Word Problems According to the Number of Components

As mentioned above, according to its components, word problem discourse's structure consists three component, which are initial situation, event (situation change), and question. Initial situation component usually contains introduction of characters, place, and time. Event component delivers the change of the initial situation because of an event. Question component asks the effect of the event and the initial situation. Ideally, a word problem includes all those three components. However, sometimes it does not cover those entire three components completely. According to the number of components, word problems in mathematics textbooks used by students and teacher from the fourth, fifth, and sixth grades in primary schools in Surakarta consist of word problems with three components and two components. There is not any word problem consisting of only of 1 component. The comparison of the data of the word problems distribution as related to the number of their components is shown in Figure 2.

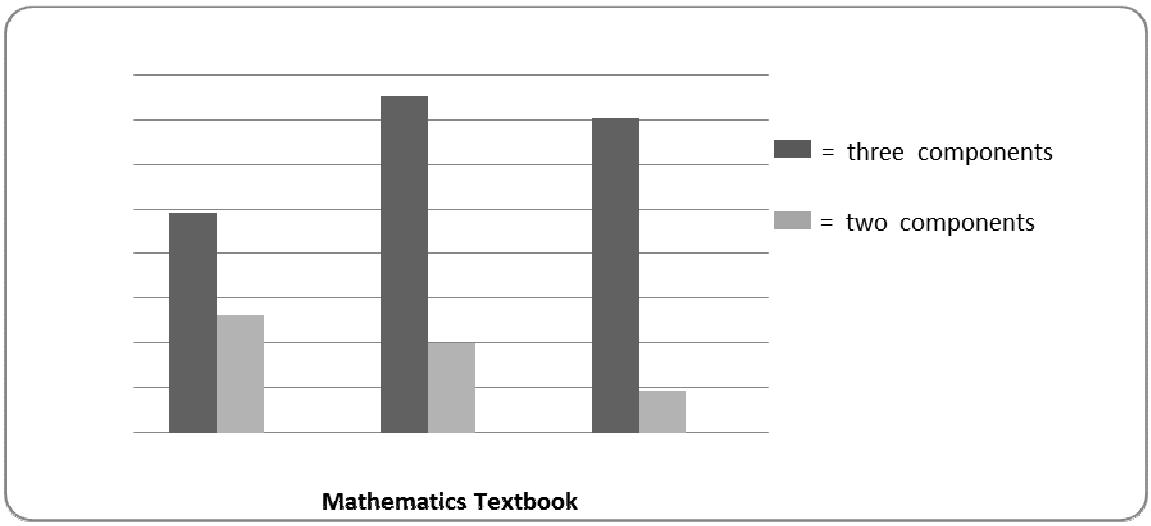

Figure 2: The Distribution of Word Problems in Textbooks According to the Number of Components

For the fourth grade students, there are 65% word problems with three components, and 35% with only 2 components respectively. For the fifth grade students, there are 79% word problems with three components and 21% with only 2 components respectively. For the sixth grade students, there are 88% word problems with three component and 12% with only two components respectively. This indicates that as the grade is higher, the ratio between the number of word problems consisting of three components and two components increases. When the grade is lower, the number of word problems with only two components increases.

Word Problem Discourse Structure Type in Textbooks

According to its structure, 1,252 word problems in mathematics textbooks for the fourth, fifth, and sixth grade students can be categorized into 6 types. The first step to categorize those six types is done by separating problems with three components and two components. The next step is to do an identification of the problems whether their components are combined for both problems with three and two discourse components. This is followed by identifying which component types are combined and what conjunction word or language element is used to combine them. The distribution for each type is shown in Figure 3.

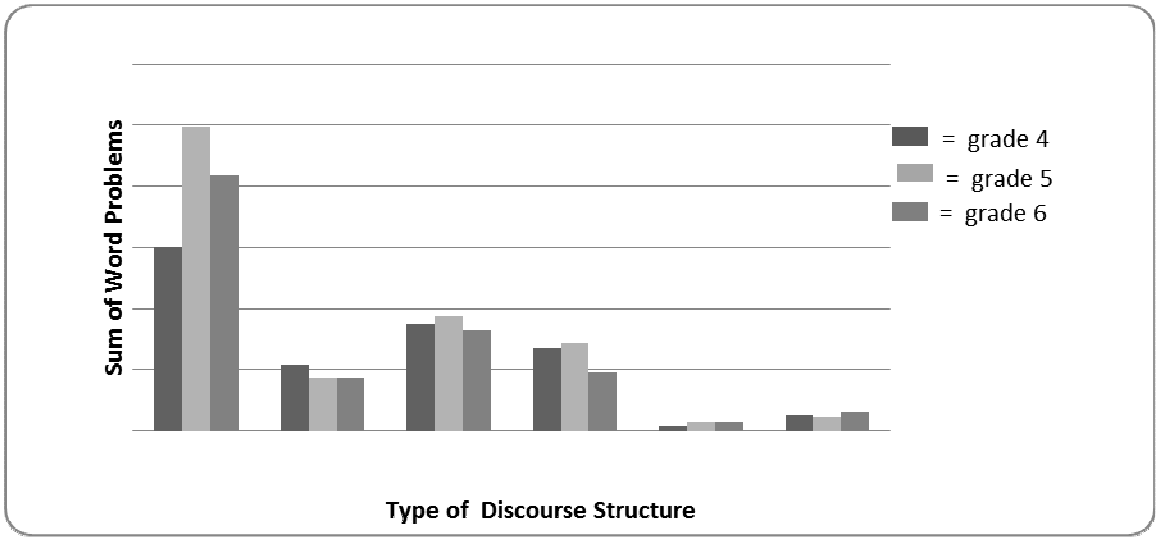

Figure 3: Word Problem Distribution According to Their Discourse Structure

The data in Figure 3 above show that for the fourth grade students, most of the word problem discourses with three components are provided with their components combined as indicated by the number of problems with combined components (TYPE I or III), that is 35%. While that of problems with separated components (TYPE I) consists of 29%. In contrast, most word problems with two components have their component separated, that is, 2%. However, for the fifth and sixth grade students, most of the problems, for both those with three components and two components, have their components separated. For the fifth grade students, there are 41% of the problems with three separated components and 37% of the problems with combined components respectively. For the sixth grade students, there are 49% of the problems with three components provided separately and 40% of the problems with their components combined. For word problems with only two components, there are 10% of the problems with separated components and only 0.8% of the problems with combined components. Thus, it can be concluded that as the grade is lower, the number of problems with all their three components combined increases. In contrast, as the grade is higher, there are fewer word problems whose components are combined.

According to their combination pattern, for the sixth grade students, there are more word problems that combine their initial situation components and event components (TYPE II) compared to the number of combinations between the event component and the question component (TYPE III). For the fifth grade students, the number of word problems with the combination between the initial situation component and the event component is approximately the same as that of the word problems with the combination between the event component and the question component. However, for the sixth grade students, for word problems consisting of three component, there are more word problems with their event component and question component combined (TYPE III) as compared to the number of word problems with their initial situation component and event component combined (TYPE II). This shows that as the grade is lower, there are more combinations with TYPE II as compared to TYPE III. In contrast, as the grade is higher, the number of TYPE III combination is greater than that of TYPE II.

TYPE I: Word Problems with three components that are provided separately with linear order, for example:

(1) *Menik dan ibunya membeli 2 meter benang putih. Mereka juga membeli 25 dm benang hitam dan 100 cm benang biru. Berapa benag yang dibeli?* 'Menik and her mother buy 2 meters of white sewing thread. They also buy 25 decimeters of the black one and 100 centimeters of the blue one. How long is the sewing thread they buy?' (fourth grade)

(2) *Setiap hari, Fachri bersepeda ke sekolah. Jarak rumah Fachri dengan sekolah 2 km Fachri sudah bersepeda sejauh 120 dam. Berapa meter lagi Fachri sampai ke sekolah?* 'Every day, Fachri goes to school by bicycle. The distance between Fachri's house and the school is 2 kilometers. Fachri has been riding for 120 decameter. How many more meters needed for him to arrive at school?' (fifth grade)

(3) *Lusi ingin membagikan coklat kepada beberapa teman di kelasnya. Setiap orang mendapat coklat sama banyak, yaitu masing-masing 4 coklat, 5 coklat, atau 6 coklat. Dia juga ingin memberi Ibu Guru 3 coklat. Berapa coklat yang harus dia beli agar dapat membagikan sesuai dengan keinginannya?* 'Lusi wants to give some of her chocolates to her friends in class. Everyone gets the same number of chocolates, that is is 4 chocolates, 5 chocolates, or 6 chocolates for each. She also wants to buy 3 chocolates for her teacher. How many chocolates she has to buy so that she could give everyone as she desires?' (sixth grade)

Word problem (1) above has three sentences that represent three components. The initial situation component is "Menik and her mother buy 2 meters of white sewing thread". The event component is "They also buy 25 decimeters of the black one and 100 centimeters of the blue one". The question component is "How long is the sewing thread they buy?" Looking from the components point of view, the initial situation component for Problem 2 is "Every day, Fachri goes to school by bicycle. The distance between Fachri's house and the school is 2 kilometers". The question component is "How many more meters needed for him to arrive at school?". In this example, initial situation component consists of two sentences. First sentence contains information about the actor and the time setting while the second sentence gives information about the place setting. The initial situation component in Problem 3 is *"Lusi wants to give some of her chocolates to her classmates. Everyone gets the same number of chocolates, that is, 4 chocolates, 5 chocolates, or 6 chocolates for each."* The event component is *"She also wants to buy 3 chocolates for her teacher"*. The question component is "*How many chocolates she has to buy so that she could give everyone as she desires?"* In this example, the initial situation component consists of two sentences. The first sentence gives information about the actor and co-actor.

According to the problems of the examples above, it can be stated that there is a difference in the number of sentences for each problem for the fourth grade students compared to problems for the fifth and sixth grade students. Although in average both contain three components, the problems for the fourth grade students consist of three sentences in average, while for the fifth and sixth students, they consist of more than three sentences in average. For the fourth grade students, the initial situation component is delivered in a sentence containing actor as well as the quantity of the first part. This is different from those for the fifth and sixth grade students whose initial situation component consists of more than one sentence. The first sentence usually contains actor, place setting, and the time when the event happens, while the second sentence contains the first part quantity. For example, in Problem 2, there are a time setting (every day) and a place (to school), while in Problem 3, there is a place setting, which is *in class* in the first sentence. The first part quantity in Problems 2 and 3 is contained in the second sentence. In Problem 3, the second sentence that explicitly contains three quantities, is categorized as the first part quantity because that quantity changes because of the presence of the second part quantity that is contained in the event component, which is "She also wants to buy 3 chocolates for her teacher". Therefore, it can be stated that that one of the event component signs is that it contains a quantity that causes the change of the first part quantity that is present in the initial situation component.

TYPE II: Word problems with three components whose initial situation component and event component are combined, for examples:

(4) *Ani masuk sekolah pukul 7 tepat dan pulang pukul 12 lebih 40 menit. Berapa jam Ani berada di sekolah?* 'Ani starts her lesson at 7 o'clock at school and finishes at 12:40. How many hours is she at school?' (fourth grade)

(5) *Pak Budi mempunyai 5 ekor kambing, sedangkan kambing Pak Ali ada 3 ekor. Berapa perbandingan kambing Pak Budi dan Pak Ali?* 'Mr. Budi has 5 sheeps while Mr. Ali has 3. What is the ratio between Mr. Budi's sheeps and Mr. Ali's sheeps?' (fifth grade)

(6) *Ilham menabung di bank selama setahun sebesar Rp500.000,00 dan mendapat bunga 7%. Berapa tabungan Ilham sekarang?* 'Ilham saves his money in bank for a year with amount Rp500.000,00 and receives interest of 7%. How much is his savings now?' (sixth grade)

Three word problem discourses above have three components each, but delivered in only 2 sentences. This is because the initial situation component and event component are combined together. In Problem 4, the initial situation component is "Ani starts her lesson at 7 o'clock at school" and the event component is "finishes at 12:40" that are combined together using conjunction *and* so that they form a coordinative equal compound sentence. The use of that conjunction word is actually improper because the event component is a continuation of the initial situation, so it should have a serial relation and the conjunction used is *then*. In Problem 5, the initial situation component is "Mr. Budi has 5 sheep". The event component is "Mr. Ali has 3". Those two components are combined using *while* conjunction word so that they form a contradictive equal compound sentence. The question component is "What is the ratio between Mr. Budi's sheeps and Mr. Ali's sheeps?" In Problem 6, the initial situation component is "Ilham saves his money in bank for a year with amount Rp500.000,00" and the event component is "receives interest of 7%." The conjunction used is *and*. The combination of those two components produces an equal subject dense compound sentence. The question component is "How much is his savings now?"

In all three problems above, it was shown that the combination between initial situation and event components causes the first part quantity and second part quantity to be present in a sentence. The combination of those 2 components is done by omitting the same sentence parts, which are subject and predicate.

TYPE III: Word problem with three components presented by combining the event component and question component, for examples:

(7) *Farid membutuhkan kain sepanjang 5 meter. Jika panjang kain yang dimiliki Farid 100 cm, berapa meter kekurangannya?* 'Farid needs a 5 meter cloth. If the length of cloth he has is 100 centimeter, how much more cloth is needed?' (fourth grade)

(8) *Di belakang rumah Pak Win terdapat sebuah kolam berbentuk balok. Panjang dan tinggi kolam sama, yaitu 1,5 m. Jika volume air yang dapat ditampung kolam 6,75 m^2, berapa panjang kolam?* 'In his garden, Mr. Win has a pond in cuboid shape. Length and height of that pond is equal, 1,5 meter. If the water volume that the pond could contain is 6.75 m^3, what is the pond's width?' (fifth grade)

(9) *Citra mengukur panjang meja tulis dengan menggunakan buku. Ternyata panjang meja tulis 9 kali panjang buku. Jika panjang buku 15 cm, berapa meter panjang meja tulis?* 'Citra measures the length of studying table with a book. The table length is 9 times of book length. If the book length is 15 centimeters, what is the length of the table?' (sixth grade)

Problems 7, 8, and 9 above each consists of three component, but its event component and question component are combined. In Problem 7, the initial situation component is "Farid needs a 5 meter cloth." The event component is "the length of cloth he has is 100 centimeters" and the question component is "how much more cloth is needed?" Both components are combined by using *if* conjunction word that is present right in front of the event component so that they form a compound sentence.

The initial situation component in Problem 8 is "In his garden, Mr. Win has a pond in cuboid shape. Length and height of that pond is equal, 1.5 meters." The event component is "the water volume that the pond could contain is 6.75 m^3" and the question component is "what is the pond's width?" Both components are combined by using *if* conjunction word.

The initial situation component in Problem 9 is "Citra measures the length of studying table with a book. The table length is 9 times of book length." The event component is "the book length is 15 centimeter" and the question component in that word problem is "what is the length of the table?" The event component and question component are combined using *if* conjunction that is put in the beginning of the sentence so that they form a conditional sentence.

According to the analysis above, it could be stated that the combination of event component and question component where the event component position is in front of the question component uses *if* conjunction words and its kind. That conjunction must be put in the front so that it forms requirement information as a child sentence that precedes parent sentence.

TYPE IV: Word problems with two components presented separately in linear order, for examples:

(10) *Seorang penjahit telah menjahit 7 kodi pakaian. Berapa jumlah pakaian semuanya?* 'A tailor has

produced 7 *kodi* T-Shirts. How many T-Shirts she has sewed?' (fourth grade)

(11) *Indonesia dijajah Belanda selama 3 1/2 abad. Berapa tahun Indonesia dijajah Belanda?* 'Indonesia was colonized by Dutch for 3 ½ centuries. How many years was Indonesia colonized by Dutch?' (fifth grade)

(12) *Jarak kota A dan kota C dalam skala 1 : 1.000.000 adalah 25 cm. Berapa jarak sebenarnya?* 'The distance between city A and city B in 1:1.000.000 scale is 25 centimeters. What is its actual distance?' (sixth grade)

Three word problems above only possess two components each. Each component is presented in a sentence. In Problem 10, the first sentence functions as event component, which is "A tailor has produced 7 *kodi* T-Shirts.". The second sentence is the question component, which is "How many T-Shirts she has sewed?" In Problem 11, the first sentence, which is "Indonesia was colonized by Dutch for 3 ½ centuries." Is the event component the second sentence, which is "How many years was Indonesia colonized by Dutch?" is the question component. In Problem 12, the first sentence, which is "The distance between city A and city B in 1:1.000.000 scale is 25 centimeters." has a function as an event component. The second sentence, which is "What is its actual distance?" serves as the question component.

According to the analysis of the discourse components, Problems 10 and 11 explicitly only have one quantity part that is present in the event component. However, implicitly, that component only contains two quantity parts. In Problem 10, the first part quantity is 7, while second part quantity is *kodi* that points at a measurement unit for number '20'. In Problem 11, the first part quantity is 3 ½, while the second part quantity is *century* that is a unit for number '100'. The hint for operation in mathematical equation is present in the question component that usually only has one alternative, which is multiplication operation. As an example, in Problem 10, the number of 7 *kodi* T-Shirts is 7 x 20 = … As a result, the information asked by the question component is the multiplication factor of the first quantity by the second quantity, in which both are present in the event component.

TYPE V: Word problems with two components combined and linear order, for examples:

(13) *Jika dalam seminggu Beni mampu membuat 175 layang-layang, berapa rata-rata layang-layang yang dibuat setiap hari?* 'If in a week Beni could make 175 kites, in average, how many kites he makes in a day?' (fourth grade)

(14) *Jika kecepatan mobil di jalan tol maksimum 100 km/jam, berapa m/detik kecepatan mobil itu?* 'If the maximum speed of a car in highway os 100 kilometers/hour, how many meters/seconds is that speed?' (fifth grade)

(15) *Jika Amin hanya mengerjakan 50 soal dari 60 soal tes, berapa persen soal yang belum dijawab?* 'If Amin only does 50 questions among 60 questions in a test, how many percent has he not answered yet?' (six grade)

For each in three problem examples above, there are only two components, which are event component and question component that are presented in a sentence by using *if* conjunction. In Problem 13, the event component is "in a week Beni could make 175 kites" and the question component is "in average, how many kites he makes in a day?" In Problem 14, the event component is "the maximum speed of a car in highway of 100 kilometers/hour" while "how many meters/seconds is that speed?" serves as the question component. For Problem 15, the event component is "Amin only does 50 questions among 60 questions in a test" while the question component is "how many percent has he not answered yet?"

Similar to problems of Type 4, problems of Type 5 have an event component that contains both first and second part quantities. For example in Problem 13, the first part quantity is *in a week* that points to 7 days unit and the second quantity is *175 kites*. In Problem 14, the first part quantity is *100 kilometers* while the second part quantity is *hours* that refers to 360 seconds. For Problem 15, the first part quantity is *50 questions* and the second part quantity is *60 questions*. The effect of the first part quantity change because of the second part quantity is present in question component, which is totally different from those of type 4. That could be seen from Problem 13, where it asks about *speed in meters/seconds*, while Problem 15 asks *percentage of questions not yet done*. Therefore, for the problems of Type 5, the question component contains information about the division operation.

TYPE 6: Word problem with three or two components presented separately, but with non-linear order, for examples:

(16) *Amin berlari sejauh 1.750 meter, sedangkan jarak yang harus ditempuh Amin adalah 3 km. Berapa meter*

lagi jarak yang harus ditempuh Amin? 'Amin has been running for 1.750 meters, while the total distance he has to travel is 3 kilometers. How many meters more he needs to run?' (grade four)

(17) *Satu kilogram cat dapat digunakan untuk mengecat dinding seluas 12 meter persegi. Dinding rumah Pak Udin akan dicat ulang. Luas dinding itu 42 meter persegi. Berapa kira-kira cat yang dibutuhkan Pak Udin?* 'One kilogram paint could be used to paint 12 meters square wall. Mr. Udin's house wall will be repainted. The wall area is 42 meters square. How much paint does he need?' (grade five)

(18) *Berapa km jarak yang ditempuh Naufal setelah berlari selama satu jam, jika dalam 25 menit Naufal berlari sejauh 2 km.?* How many kilometers of distance that Naufal has traveled after running for one hour, if in 25 minutes he could run as far as 2 kilometers? (grade six)

In Problem 16, the initial situation component is "Amin has been running for 1.750 meters" and the event component is "the total distance he has to travel is 3 kilometers" which are combined together using *while* conjunction. The use of this conjunction word is actually improper since both parts of that sentence do not possess contradictive relation. Looking from the order of the information, the second component should function as the first component, which is the initial situation, while the initial situation is supposed to have functioned as event component. Therefore, the discourse structure for Problem 8 should become "Amin joins a running competition with 3 kilometers travelling distance. Amin has been running for 1.750 meters. How many meters more he needs to run?" That position switch, other than make it easier for students in understanding the problem, also suitable with language logic. For that problem, the question component is "How many meters more he needs to run?" For Problem 17, the one that is supposed to become the initial situation component is "Mr. Udin's house wall will be repainted. The wall area is 42 meters square" that was mistakenly put after the event component, which is, "One kilogram paint could be used to paint 12 meters square wall." The question component is "How much paint does he need?" In Problem 18, the components exist are only event component and question component that are combined together by using *if* conjunction in between of those 2 two components so that the position of the question component is in front of the event component. Therefore, it is said that position of those two components is not linear and that problem should become "If in 25 minutes he could run as far as 2 kilometers, How many kilometers of distance that Naufal has traveled after running for one hour?"

DISCUSSION

Word problem discourses done by lower grade students are relatively shorter

From the discourse structure point of view, word problem is constructed of three components, which are initial situation, event, and question. However, in reality, there are not few problems that consist only of two components, especially in the textbooks for the fourth grade students. Besides, judged from their type, the discourse structures with three components in those books are relatively shorter, because their initial situation component only consists of one sentence in average compared to the word problems in textbooks for higher grade students which in average has two sentences for that component.

Initial situation component that consists of several sentences makes it possible to deliver more narrative elements that contain actor. This is applicable for textbooks for students in grade V and VI who have initial situation component that contains richer narrative elements, which could be time setting and/or place setting, besides actor. As the number of narrative elements decreases, in word problems, according to Greer, Cerschaffel, and De Corte (2000), makes the problem context to be ambiguous and makes students to focus only on the question component. Zan (2010) found that word problems with minimum narrative support makes the requirements on story logical aspects to be unsatisfied in that word problem. That causes students, especially kids, to face difficulty in representing the problem into mathematical equation.

Word problems with two components are less interesting for primary school students

According to the description of the discourse structure type, there are word problems that consist of only two components, event component and question component. Therefore, the one that is omitted is the initial situation component, which basically has a role to construct the context completely and to make it suitable with students' interests related to the story elements. Therefore, these kinds of problems, by Gerofsky (1990), are indicated as problems that are not interesting for students. This could be seen from other findings on the word problem by Gerofsky (1996), which is made by students to show that the initial situation component is generally made like a story, which contains actor, setting, and other objects that are actually not really related with that problem's solution. This could also be related to the word problems that are made by students, showing the phenomenon

that there is students' preference, and a word problem discourse should have all its three component completely (Philips, 2002:20). This is supported by the research result by Roux (2008:8) who identifies that if students are asked to choose, they prefer to do the word problems with three separated components rather than those with their initial situation and even components combined (becomes one sentence). This shows that the discourse structure problem could become source of difficulties for students in understanding the problem.

According to several research results, there is an effect of the completeness and the position of the word problem discourse's components to the difficulty level for the students to understand the problem. Another research result shows that language construction, especially operation property pointer semantic structure, also influences the complexity of the word problem (Gerofsky, 1996). This also applies with things that are related with the narrative components in the problem, which are actor (the number and relation among actors) setting, and theme. Those components could increase students' interest to understand the word problem discourse (Zan, 2010). If that component is applied according to their interest, students will get motivated to read it seriously. This could be related with the Silver research finding (Reed, 1999:104) which states that the story telling factor in word problem still becomes the main attention for students, including those who are not really good in mathematics.

Initial situation component as a bridge between real world and mathematics

In mathematics textbooks, it is also found that there are word problems that consist only of two components, categorized as Type 4 (both components are independent) and Type 5 (both components are combined). In those kinds of problems, the one omitted is the initial situation component, whereas Rowland (2008:4) states that initial situation component holds a very important function and role in connecting the real world with mathematics so that the presence of actor and setting in word problems become a media for that purpose. Regarding that matter, Galliher (2004:2) argues that problems that is represented in the form of words or story gives an impression of how mathematics could be used in the real world so that its role in connecting mathematics with real world could be realized. This is supported by strong finding of research in Kubala (in Rowland, 2008:6) stating that students majoring in electrical often make use of their experience in solving mathematics word problem with that character in doing practical works in the field. Relevant to it, Sarukkai (2001:666) states that word problems are basically form of translation from non-word problems, but, semantically, non-word problems have meaning that is limited while word problems are richer in meaning because of the support of their narrative elements inside. Besides that, according to Gerofsky, the use of narrative elements (actor, place, and time) which are relevant with daily life of students makes the word problem discourse to be more realistic and interesting for students to solve it because it has been proven that they prefer that kind of problems to be done compared to other types (1996:39)

From many researches, it is found that one of the factors causing students' skill in solving mathematics problems to be low is because the teaching in mathematics is irrelevant to mathematical experience in the real world (Evans, 2001:25; Gravenmeijer, 2001 : 112). Mosvold even finds that the teaching of mathematics in Netherland is considered to be more successful than that in Japan because the problems presented in the textbooks in Netherland is developed by the schools by referring to the real life, while in Japan, only small portion who refers to the real life of their people (2008:225). Therefore, mathematics experts argue that in order for the problems to be easily understood by students, the problems presented must reflect the real world faced by students or relevant to the real context. If the context in the problem is not known to students, it may be difficult for them to understand it. In the opposite, if the problem context is known, or even familiar to students, it may be easier to understand it.

There are some models or procedures used to develop word problem discourse. The first model is developed by Galliher (2004) to primary school students. The procedure is described as follow. *First step*, students together with their teacher develop a word problem based on their experience or situation surrounding, for example, a student is asked to tell how his or her pocket money was used, or the number of games they have with addition, subtraction structures or combination of both of them for beginning class, while addition, subtraction, multiplication, and division structures for advanced class. *Second* based on that story, other students together solve it. *Third* students together with teachers discuss the solution of that word problem. The word problem topics are, other than based on students' experience, also based on the pictures prepared by teachers.

Combination of discourse components produces a complex sentence structure

To measure the quality of the word problem, other than looking it from its structure, (Verschaffel, Greer, and De Corte, 2000:3) suggest that problem is evaluated based on three factors. Those three factors are: (1) linguistic

degree, (2) mathematical operation degree, and (3) mathematical symbol representation. Linguistic degree is related to various language variables, like number of syllables or the length of word problem sentence. Mathematical logic degree could be classified into several methods, but the easiest is based on the number of mathematical operation in a problem. Problem that contains less mathematical operation (for example, only an addition) is easier to be solved as compared to those with more mathematical operations in it (for example by a combination of multiplication and division). The symbolic representation is related to the use of mathematical symbols, like m and m^2, cm and cm^2. Symbols which are form of derivation (m^2 and cm^2) are more difficult compared to those which are not form of derivation (m and cm). Verschaffel, Greer, & De Corte (2000) put linguistic degree in the first order because according to their research, that factor is mentioned as the one that is most influential to the difficulty level in translating the problem. The combination among components in word problem discourse like those found in mathematics textbooks, especially for the fourth grade students, could be a source of difficulty for students in understanding the problem. This is because the combination among components in word problem produces a complex sentence, which is an equal compound sentence or multilevel compound sentence. The use of sentence pattern that consists of clauses could be one of difficulty sources for students in understanding the language in word problems (Caldwell & Godin, 1979:328)

CONCLUSION

Word problem discourses in mathematics textbooks for the fourth grade students are less than those for the fifth and sixth grade students. Based on the number of components, the number of word problems with two components for the fourth grade students 4 is greater than that for the fifth and sixth grade students. In addition, the problems with three components for the fourth grade students are presented shorter than those for the fifth and sixth grade students because their initial situation components only consist of one sentence, while those for the fifth and sixth grade students have two sentences in average. The initial situation components can present a clearer story context if it is delivered by making use of more narrative elements, like time setting and place setting in addition to actor. Therefore, it is recommended for the teachers of primary schools modify the problems presented in mathematics textbooks so that the students are easier to understand their contents.

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