Contextual Features of Geometrical Problems in Indonesian Mathematics Textbooks

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Abstract. This study aims to analyze series of Indonesia mathematics textbooks by observing whole tasks and its association with contextual features in geometry topic presented in the textbook. The study was carried out as there are only few studies conducted research on analysis of a textbook for geometry topic. A research method used in the study was textbook research employed in this study to achieve the purpose. The analysis was performed for 9 textbooks from 3 different well-known publishers (Kemendikbud, Erlangga and Yudhistira). Results show that it is more than 25% in average of whole pages in the textbook present geometry topic and there are more than 80% of geometric questions in the textbook belong to intra-mathematical context that is question not related to the real life. Details and further discussion will be elaborated in this paper.

1. Introduction
Indonesia has performed 9 times changes on educational curriculum since sovereign. It leads to the adaptation of structure and material content taught to students as the curriculum specifies them. Also, it is normally adjusted to the learning process needs for both teachers and students.

The initial means to review a curriculum is conducted by researchers through analyzing their textbooks [1, 2]. This is plausible as textbooks are a representation of the curriculum implemented in a learning process in a class.

Textbook is one of the necessary tools in a learning process to obtain a learning achievement owing to the fact that it has mighty relevance to the way students learn and the learning activities in the classroom. In the Regulation of the Minister of Education and Culture No. 8 of 2016, textbooks are the principal operational tool for implementing the curriculum. It is clarified in verse 1 that textbooks are the major learning resource to achieve both basic and core competencies. Also, they are declared worthy to use in education units as said by the Ministry of Education and Culture.

In this study, we focus on the mathematics textbook of Junior high school on Geometry topic. Geometry is one branch of mathematics that has been embedded early in formal school. However, there are few studies on investigative textbooks that focus on geometry [3], particularly in the context of Indonesian mathematics textbooks. Moreover, research on geometry has been very rare [4-6].

Usiskin [7] stated reasons why geometry should be taught. First, geometry is the one and only field of mathematics link with physical forms of the real world. Second, geometry is likely to visualize mathematical ideas. The third is geometry provides a non-singular example in a mathematical system. Therefore, it is legitimate that geometry has been embedded early in the curriculum.
In the textbook, students will find various forms of tasks, both in the form of sample questions, exercise questions and competency test questions. Some researchers examined the task based on several aspects, including the form of answers [8, 9] and contextual features [8-10], and several other aspects (e.g. cognitive demand in mathematics). In this paper, we focus on aspects of contextual features. In textbooks, the geometrical problem is likely to associate mathematics to physical form in the real world should be equilibrated with tasks related to the context of students. As a result, they can be engaged in mathematics and have a sense of application in the real world. However, not a few can be found there are problems that are not related to the daily concept. This is as revealed by Yan and Lianghuo [8] that geometric problems belong to problems that can be applied and cannot be applied in daily life. Furthermore, problems in daily life can be fictitious and authentic. The application of the fictitious problem is deliberately made by the will of the author. Thus, the selected data is not in accordance with the truth. It is different from authentic which takes data based on data and/or situations in daily life of the reader itself. Gracin [9] mentioned the types of problems related to these contextual features in terms of intra-mathematical context, realistic context, and authentic context.

According to the outlines above, this study aims to analyze Indonesian mathematics textbooks related to contextual features in the geometrical task. In other words, the focus of research is on geometry material and emphasized on aspects of the contextual features.

2. Methods
The research method used is the analysis of textbooks or textbook research. Textbooks research can be carried out with several types, they are one textbook analysis or series of similar textbooks, and unsimilar types from the same country or often different countries, generally focusing on identifying similarities and differences [11]. In analyzing, this study compared several 2013 curriculum mathematics textbooks for the level of Junior high school in Indonesia.

| Grade | Textbook Code | Title | Publisher  | Year  |
|-------|---------------|-------|------------|-------|
| VII (Seventh) | K7 | Matematika SMP/MTs kelas VII Semester 2 | Kemendikbud | 2014 |
|     | E7 | Matematika untuk SMP/MTs Kelas VII | Erlangga | 2014 |
|     | Y7 | Jelajah Matematika 1 | Yudhistira | 2013 |
| VIII (Eight) | K8 | Matematika (Semester 1 & 2) | Kemendikbud | 2014 |
|     | E8 | Matematika SMP Jilid 2A dan Jilid 2B | Erlangga | 2014 |
|     | Y8 | Jelajah Matematika 2 | Yudhistira | 2014 |
| IX (Nine) | K9 | Matematika SMP/MTs Kelas IX | Kemendikbud | 2015 |
|     | E9 | Matematika SMP Jilid 3A & Jilid 3B | Erlangga | 2015 |
|     | Y9 | Jelajah Matematika 3 | Yudhistira | 2015 |

Objects of this study are 9 Indonesian mathematics textbooks 2013 curriculum for Junior High School grade of 7, 8 and 9 (see Table 1). Source of these textbooks is from 3 different publishers such as public (government) publisher i.e. Kemendikbud, and 2 private publishers namely Erlangga and Yudhistira. They are selected for this study as they are ordinarily referenced in school in Indonesia.

Technique and procedure used for analyzing data were horizontal and vertical analysis [12]. Horizontal analysis emphasizes physical characteristic and the material structure in the textbooks. Meanwhile, vertical analysis concerns the mathematics concept delivered to users.

The vertical analysis of all task is classified and coded based on the contextual feature. It consists of intra-mathematical context (C1), realistic context (C2), and authentic context (C3). The task from intra-mathematical context is an activity asserting students to express mathematics ideas without relating to the daily life context. On the contrary, realistic and authentic context interconnect to the real-world problems. The different of these features is the realistic context linking to the data made by the author while authentic context based on the real situation and the data for the readers.
These three contextual features are coded by the second author and verified by the first, third and fourth author. They gave feedbacks according to the occurring variation. The analysis was carried out approximately 5 months for certifying the accuracy. For each variation, it would be re-examined, discussed, and revised. After revising, analysis descriptive qualitatively was executed on the coding result.

3. Results and Discussion

3.1. Outline of the textbooks

According to the horizontal analysis for each textbook, the significant difference was in a number of chapters associated to geometry in grade 7. Y7 textbook comes out 1 chapter merely for geometry. It is with reference to rectangular and triangle for 40 pages covering 8 sub-chapters which are special rectangular, circumference and area of rectangular, area of irregular 2-dimensional figures, types of triangle, drawing a special line in triangle, circumference and area of triangle. It is different from two other books presented the topic on triangle and rectangular. In grade 8 and 9, both present with the same of the number of chapters. Summary of the analysis is presented in Table 2.

| Textbook Code | Total of pages | Number of chapters | Total of Sub-chapters | Geometry (pages) | Percentage of the pages (%) |
|---------------|----------------|--------------------|-----------------------|------------------|-----------------------------|
| K7            | 440            | 2                  | 7                     | 88               | 20                          |
| E7            | 385            | 2                  | 21                    | 88               | 22.86                       |
| Y7            | 239            | 1                  | 8                     | 40               | 16.74                       |
| K8            | 378            | 4                  | 15                    | 120              | 31.75                       |
| E8            | 394            | 4                  | 25                    | 140              | 35.53                       |
| Y8            | 274            | 4                  | 16                    | 86               | 31.39                       |
| K9            | 272            | 2                  | 7                     | 93               | 34.19                       |
| E9            | 363            | 2                  | 12                    | 91               | 25.07                       |
| Y9            | 213            | 2                  | 6                     | 55               | 25.82                       |

3.2. Contextual features

In this part, we describe results associating to the contextual features in the geometrical task. Details for each grade would be illustrated in some paragraph below.

In the K7 textbook, there are 100 items related to geometry material with 80 items (80%) questions of type C1 and 20 (20%) items of type C2. These items are divided into 28 sample questions, 57 exercise questions and 15 competency test items. The E7 textbook has 319 geometry related questions. Question items of type C1 numbered 216 items (90.28%), items with type C2 numbered 30% (9.40%), and 1 item (0.31%) questions with type C3. These items are divided into 70 sample items, 187 exercise questions and 62 competency test items. The Y7 textbook has 148 items with 136 items (91.89%) including C1 and 12 items (8.11%) other questions of C2. These items are divided into 40 sample questions, 77 exercise questions, and 28 competency test items. Based on the analysis, these three textbooks of class 7 are more dominant in the aspect of the Intra-Mathematical Context.

The K8 textbook has a total of 191 items related to the geometry. The item number of C1 type is 161 items (84.29%), C2 type is 29 items (15.18%) and C3 type is 1 item (0.52%). These items are divided into 27 items of sample question, 106 items of exercise, and 58 items of competency test. The E8 textbook has a total of 440 items related to the geometry which are divided into 347 items (78.86%) of C1 type and 93 items (21.14%) of C2 type. These items are divided into 80 items of sample question, 258 items of exercise, and 102 items of competency test. The Y8 textbook has 257 items related to the geometry. These items are divided into 40 items of sample question, 127 items of exercise, and 90 items of competency test. The number of C1 type is 197 items (76.65%), while C2 type is 60 items (23.35%).
According to these three analyses, the items are dominated by intra-mathematical context task and only 1 item for authentic context.

The K9 textbook has 159 items related to the geometry. It is classified into 133 items (83.65%) for C1 type and 25 items (16.35%) for C2 type. These items are divided into 29 items of sample question, 85 items of exercise, and 45 items of competency test. The E9 textbook has 302 items related to the geometry. There are 56 items of sample question, 193 items of exercise, and 53 items of competency test. The items are classified into 231 items (76.49%) for C1 type and 71 items (23.51%) for C2 type. The Y9 textbook has 205 items related to the geometry which there are 141 items (68.78%) C1 type and 64 items (31.22%) C2 type. These are divided into 30 items, 120 items, and 55 items for sample question, exercise, and competency test respectively. Hence, there is no task form of authentic context type for these three textbooks for grade 9.

The analysis results for the three different grade levels above can be seen in Table 3. Each contextual feature is divided into three aspects and presented in the form of a percentage.

Table 3. Percentage of problem types of contextual features in the textbook.

| Textbook code | Contextual Features |
|---------------|---------------------|
|               | C1 (%) | C2 (%) | C3 (%) |
| K7            | 80      | 20     | 0      |
| E7            | 90.28   | 9.40   | 0.31   |
| Y7            | 91.89   | 8.11   | 0      |
| K8            | 84.29   | 15.18  | 0.52   |
| E8            | 78.86   | 21.14  | 0      |
| Y8            | 76.65   | 23.35  | 0      |
| K9            | 83.65   | 16.35  | 0      |
| E9            | 76.49   | 23.51  | 0      |
| Y9            | 68.78   | 31.22  | 0      |
| Average       | 82.77   | 18.70  | 0.09   |

Table 3 shows that based on each grade level, textbooks published by the private sector still dominate in terms of quantity to present the mathematical task to the readers which is above 90%. This also occurs for 8th grade (above 75%) and 9th grade (above 60%) mathematics textbook. However, the number of quantities of a task does not guarantee the learning process become effective and efficient to understand the concept and other skills. One of the causes this is inadequate examples, exercises, and/or competency tests related to the contextual context, particularly the authentic context. Most of the textbook are dominated by those related to the intra-mathematical context (more than 80% on average) as exemplified in Figure 1.

Figure 1. The example of Y8 question Intra-Mathematical Context type
Translation:
Determine the surface area of chocolate box with the length of side is 12 cm, 8 cm, and 5 cm.

Textbooks dominated by problems related to intra-mathematical context more emphasize on low order thinking problems than high order thinking problems [9]. This is coherent as intra-mathematical context problems more require an ability to memorize and are flexible in applying procedural knowledge than utilize reasoning, conceptual knowledge, and mathematical connections. Moreover, it has been found by the researchers that mostly the textbooks which has been analyzed are dominated by unrealistic problems [8, 9]. Excessive emphasis on memorizing skills and knowledge of procedures without being based on strong knowledge will be difficult to reflect on and evaluate errors, also hinder to establish connections between procedures, understanding and related contexts, and inhibit the development of mathematical competencies [13, 14]. The findings of this study is also in accordance with the findings of Wijaya and his colleagues [15, 16] that inadequate opportunity to learn about context-based tasks provided by teachers of difficulties in solving context-based tasks.

Furthermore, the findings of this study also indicate that all textbooks analyzed were lacking in presenting contextual problems, especially authentic context aspects. In class 7, only one private-issue textbook (E7) presents the task of authentic context, which is 0.31% of the total geometrical task. In class 8, the government-issued textbook also only presents 1 task (0.52%) about authentic context. The item can be seen in Figure 2. Ironically, in class 9, there was not found 1 item authentic context for each textbook analyzed but book Y9 provided more opportunities for realistic context related-tasks than the results of analysis of other textbooks. One item task related to realistic context can be exemplified in Figure 3. This finding indicates that student activity to rediscover a concept is very minimal given the opportunity. This is contrary to the nature of mathematics as a human activity as stated by Freudenthal [18]. Authentic context related-task provides opportunities for students to develop a sense of the material and real-life linkages and make mathematical activities that encourage the construction of concepts.

**Figure 2.** The exercise question of Authentic Context from K8 textbook.

Translation: Pick six the real stuffs surrounding you, then measure and find out the surface area and the volume (through showing the examples of figures below).

**Figure 3.** The question of competency test of Realistic Context in the E7 textbook.

1. Lantai ruangan sebuah rumah berbentuk persegi panjang dengan ukuran panjang 5 m dan lebar 3 m. Lantai itu akan ditutup dengan ubin berukuran 30 cm × 30 cm. Hitunglah banyak ubin yang digunakan untuk menutupi lantai tersebut!
Translation:
The floor of a room is rectangular which has the length 5 m and the width 3 m. The floor will be covered with tiles 30 cm × 30 cm. How many tiles used to cover the floor?

4. Conclusion
This study examined the contextual features of Indonesian mathematic textbooks containing the 2013 curriculum. The findings of the study indicate that most of the textbooks used for learning in the Indonesia schools are still lacking in the contextual feature particularly for authentic context feature. This can be verified by only 1 textbook (private publisher) that reaches more than 25% of the total of geometrical tasks in the textbook. It implies that teaching will lead to a performance orientation and procedural knowledge without based on the conceptual knowledge and related to the realistic.

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