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How textbooks serve as the media to develop students' higher order thinking skills: A comparison between Indonesian and Laotian mathematics textbooks

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Abstract

The results of the Programme for International Student Assessment and the Trend in International Mathematics and Science Studies revealed that many students in developing countries had unsatisfactory results in terms of their mathematical literacy and higher order thinking skills. Considering Indonesia and Laos are both developing countries, it is important to compare their education to get a better understanding about the similarities and differences in students' performances. In this study, this comparison was narrowed down to mathematics textbooks. Analyzing textbooks was chosen because textbooks are an essential factor influencing students' mathematics achievement. Therefore, content analysis was used to compare the Indonesian and Laotian mathematics textbooks. The units of analysis were mathematics tasks in the textbooks, whereas the analysis framework was based on Bloom's Taxonomy. The results of textbook analysis shown that in general Indonesian mathematics textbook provided more tasks addressing higher order thinking skills (HOTS) than the Laotian mathematics textbook did. With respect to lower order thinking skills, the Laotian mathematics textbook appeared to rely more on memorization and less on understanding and applying when compared to the Indonesian mathematics textbook. With respect to HOTS, lower frequency and percentages for analyzing and creating was found in the Laotian mathematics textbooks.

Keywords: higher order thinking skills, textbooks, Indonesia, Laos

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INTRODUCTION

The role of mathematics in life is very important because the mastery of mathematics is needed by students as a provision in facing the rapid development of science. Students are not only required to understand mathematics but are also required to make optimal use of their knowledge to solve more and more complex problems (Maslihah, Waluya, Rochmad, & Suyitno, 2020). This situation has led to an emphasis on connecting education to student's lives, which implies that education should have as its goal to close the gap between how students learn in school and how they deal with everyday life. Knowledge gained through education, therefore, should provide students not only knowledge but also the skills necessary for life and support of their community (Wijaya et al., 2015). With respect to those ideas, there is an increasing attention towards students' ability to apply mathematics concepts in various situations including daily life problems.

Despite the increasing attention towards students' ability to apply mathematics, various studies shown that many students struggled when dealing with problems situated in contextual situation. Solid evidence for this situation is the results of the Programme for International Student Assessment (PISA). PISA is a large-scale assessment which focuses on assessing students' ability to apply mathematics in various situations (OECD, 2003). Such ability is mainly referred to mathematical literacy. From PISA 2000 to PISA 2018, many students in developing countries could not reach Level 2 which is considered

as the basic level of mathematical literacy (OECD, 2001; 2004; 2009; 2013; 2019). These students could not solve problems with complex context and implicit indication about the required mathematics.

Mathematical literacy is not the only important competence to be acquired by students. From a broader perspective, higher order thinking skills is also essential for students. Higher order thinking skills do not only deal with ability to apply mathematics, but in more general perspective are about the ability to analyze, evaluate, and create. An international assessment that is aimed to measure students' higher order thinking skills is Trends in International Mathematics and Science Study (TIMSS). TIMSS is aimed to measure the achievement of fourth and eighth graders in mathematics and sciences. In contrast to PISA which is considered to be curriculum free, TIMSS has an attachment to curriculum content. In order to measure students' mathematics performance, TIMSS uses mathematics tasks that comprise two domains, i.e. content domain and cognitive domain (Mullis & Martin, 2013). Content domain refers to the mathematics contents or topics which are assessed. Cognitive domain focus on measuring the level of students' cognitive skills. These skills include knowing, applying, and reasoning. Among these three cognitive skills, reasoning is highly related to higher order thinking skills. The reasoning domain focuses on non-routine problems with complex contexts that require multiple steps. Similar to what has been revealed by PISA, TIMSS also found that many students in developing countries had low reasoning skills.

Lao and Indonesia are both developing countries. The Lao Peoples Democratic Republic (Lao PDR) or also known as Laos continuously attempts to improve the education system. Lao's current education system is based on education reform which is regulated according to the national education in 1999. Significant changes from this education reform lie in the implementation of a uniform policy, the flexibility of the implementation of the policy, decentralization, guarantees the quality, training to improve the quality of teachers at all levels, and mobilization of resources (Sciences & Pdr, 2016). The official education curriculum uses in Laos is based on a curriculum that was established more than 10 years ago. In 2008, the national curriculum for basic education in 2008 was designed to emphasize conformity. The curriculum focused on model understanding by design framework (UbD). The UbD framework has been used since 2008. The UbD framework helps to focus on curriculum, and to teach the development and to further student understanding and transfer of learning. The objective of decentralization is to prioritize within the 2008 national curriculum, by providing opportunities for local communities and schools to develop their school curriculum that is more applicable to the respective environment. Teaching and learning activities that can be applied to all Laotian students in primary education to improve the quality of students in mastering the basic knowledge and life skills necessary to face the continuing changing world. Therefore, they must be equipped with the spirit to search for knowledge to develop themselves in a sustainable manner (EFA 2015 Review Group and Secretariat Grou, 2015).

Indonesia is a developing country, but the quality of education in Indonesia ranges on the top of Southeast Asia region countries. With respect to mathematics education, Indonesian curricula take into consideration that the subject of mathematics should target developing student's ability to: (1) understand the concepts of mathematics, explain the relevance of concepts, and flexibly apply the concepts or algorithms in problem solving; (2) solve problems that require the ability to understand a problem, design and complete a mathematical model to solve it, and interpret the solution; and (3) appreciate the purpose of mathematics in life (Rahdiyanta, 2003). This educational goal is also considered in the Curriculum 2013 in which the Indonesian government mandates that education must be relevant to one career development and offers students opportunities to apply their knowledge in society. According to the Ministry of Education and Culture No. 35 of 2018 (Permendikbud, 2018) concerning the 2013 curriculum, mathematics learning at the junior secondary school consists of five hours of lessons per week. More time to learn mathematics compared to other subjects. Mathematics subjects has many applications in the curriculum in various countries because mathematics is necessary for solving problems faced by humans outside of school, in daily life as well as on the job.

Considering both Lao and Indonesia are developing countries, it is interesting to see the similarities or differences between the two countries with respect to mathematics education in particular about developing students' higher order thinking skills. This comparison can be narrowed down by

focusing on the textbooks used in the two countries. Content of textbooks is often considered as a measure of opportunity to learn because it is an important factor that might influence students' achievement. Several studies revealed a relation between students' performance and the content of textbooks they read (see: Tornroos, 2005; Wijaya, van den Heuvel-Panhuizen, & Doorman, 2015; Xin, 2007). In comparison to the influence of curricula, textbooks play an even more direct role in what is addressed in instruction. Teacher's decisions about the selection of content and teaching strategies are often directly set by the textbook that the teachers use. They are commonly considered as a source of explanation and exercises for students to learn and for teachers to teach, and an important indicator for the opportunities to learn mathematics (Pepin & Haggarty, 2001). In mathematics education, a great deal of attention has been attributed to developing textbooks to apply in education. The National Council of Teachers of Mathematics (NCTM), for example, states that the mathematics curriculum should focus on "mathematics textbooks that will prepare students for continued study and for solving problems in a variety of school, home, and work settings" (Keller, Hart, & Martin, 2001).

Considering the importance of textbooks in the learning of mathematics, this study is aimed to analyze and compare Indonesian and Laotian textbooks from the perspective of higher order thinking skills. Analyzing textbooks can make important contributions to an understanding of a curriculum in a particular country. It would serve to provide a window into the educational system, which might lead to an indication of the students' intended learning. Many researchers believe the textbook is an important factor in student's mathematics achievement. Therefore, it is expected that by analyzing textbooks which are used in Indonesia and Laos can give clear insight about the differences or similarities of students' mathematics performance in the two countries.

METHODS

Type of Research

This research was qualitative research using techniques of content analysis. Krippendorff, (2013). Content analysis is defined as a research technique for making valid replications and conclusions from the text to the context of the textbook (Ramelan, 2019). Cohen, Manion, and Morrison (2017) also define that content analysis is a process of inferring and reporting on the subject matter and message from the data written. The approach in the content analysis was not only quantitative but also qualitative because all the readings in the textbook are qualitative even though expressed in numbers. Although a character from the textbook and then converted into numbers, the data were described using a qualitative approach.

The objective of this qualitative research content analysis was to determine the Laotian and Indonesian mathematics textbook content from the perspective of revised Bloom's Taxonomy. The mathematics textbook content was analyzed by using the directed technique. This research was based on coding and recording from the six levels cognitive domain of revised Bloom's Taxonomy.

Data Sources

The selected mathematics textbooks in the two countries were analyzed from the perspective of revised Bloom's Taxonomy. The exact Laotian mathematics textbook used for this analysis was the grade VII student mathematics textbook entitled "Lower Secondary School Mathematic Textbook Grade VII (ແບບຮຽນຄະນິສາດ ຊັ້ນມັທະຍົມ ປີທ2)" officially issued by the Laos government through the curriculum 2008 of the Ministry of Education and Sport. This mathematic textbook was written by Prof. Seo Moladok, Sin Thoamathevo, Boualy Keovongsa, and Ounkeo Sivisai. The Indonesian mathematics textbook used in this analysis was the grade VII student mathematics textbook entitled "Lower Secondary School Mathematics Textbook Grade VII (Matematika SMP/MTs Kelas VII)" officially issued by the Indonesia government through the center for curriculum, and textbooks 2013 (Puskurbuk). This mathematics textbook was written by Abdur Rahman As'ari, Mohammad Tohir, Erik Valentino, Zainul Imron, dan Ibnu Taufiq.

Data Collection: Techniques and Instrument

The data collection techniques in this research were carried out by using observation and recording techniques. The purpose of this research was to explore the similarities and differences between the geometry tasks in Laotian mathematic textbook and Indonesian mathematic textbooks taught in lower secondary school grade VII from the perspective of revised Bloom's Taxonomy. The researcher has observed and analyzed the geometry tasks "geometry exercise (*Soal latihan*)" in the two selected textbooks based on the six cognitive levels of revised Bloom's Taxonomy in Remembering (C1), Understanding (C2), Applying (C3), Analyzing (C4), Evaluating (C5) and Creating (C6).

The data collection methods and procedures were used to analyze the geometry tasks were based on the six cognitive levels of the revised Bloom's Taxonomy. First, the researcher analyzed the geometry tasks based on the dimensions of cognitive processes, then inputted into the Taxonomy table outlined in the mathematic textbook content analysis sheet. The analysis sheet was adjusted to the characteristics of each textbook content and adjusted to the six cognitive levels of the revised Bloom's Taxonomy. Indicators of the six cognitive levels of revised Bloom's Taxonomy which were used as the analysis framework are presented in Table 1.

Table 1. Analysis Framework

Cognitive Levels		Indicators
LOTS	C1	Remembering is the ability to recall information or knowledge stored in memory.
	C2	Understanding is the ability to understand instructions and affirm the meaning or meaning of ideas or concepts that have been taught either in oral, written, or graphical forms.
	C3	Applying is the ability to do something and apply a concept in a certain situation. Example: Process payroll following the applicable system.
HOTS	C4	Analyzing is the ability to separate the concept into several components and connect again to gain an understanding of the concept as a whole.
	C5	Evaluating is the ability to determine the degree of something based on certain norms, criteria, or standards.
	C6	Creating is the ability to combine elements into a new form that is whole and coherent, or to make something original.

Data Analysis

The steps of data analysis in this research were adjusted to horizontal and vertical analyses according to (Charalambous, Delaney, Hsu, & Mesa, 2010) and adopted the step of content analysis according to (Krippendorff, 2013). These steps were:

1. Unitizing (Define Unit)
   The material used for the analysis in this research was geometry exercise. First, the focus of analysis was defined, i.e. the geometry unit in the Laotian and Indonesian mathematics textbooks. Second, it was defined the geometry unit in the two selected textbooks analyzed from the perspective of revised Bloom's Taxonomy. Finally, the geometry exercise including each sub-questions of the exercise in the textbook was counted for analysis based on the six levels of revised Bloom's Taxonomy
2. Recording/Coding
   The recording was carried out by the researcher and rater. Analysis framework as shown in Table 1 was used as the main tool to analyze the textbooks. The researcher and external rater analyzed the textbooks content independently based on the methods that have been made and took notes on the analysis sheet. Before analyzing, researchers and rater conducted discussion to equalize framework perceptions and examples. Rater only analyzed 50% of the total material analyzed by the researcher. Rater provided the assessment on the analysis sheet to provide a checklist (√) according to the actual situation. This research applied double coding so that researchers and rater can provide more than one checklist (√) for each unit analyzed. The results of the analysis for each textbook load unit analyzed contained the six levels of revised Bloom's Taxonomy.

3. Inferring
   This section was performed by analyzing the data to find the meaning of existing units. The following steps were the required steps that led to conclusions. Researchers inputted the data from the analysis of the contents of the Laotian and Indonesian mathematics textbooks. Researchers performed inter-rater reliability calculations to determine the agreement between rater and researcher (see Table 2). Researchers discussed and drew conclusions using the results of the percentage calculated. The results of the analysis of the Laotian and Indonesian mathematics textbooks were presented in the tables and graph the perspective of revised Bloom's Taxonomy.

Table 2. Inter-rater reliability for the coding process

Cognitive Levels	Kappa Value	Category
C1	0.85	Substantial
C2	0.82	Substantial
C3	0.79	Substantial
C4	0.75	Substantial
C5	0.67	Substantial
C6	1.00	Almost perfect

RESULTS AND DISCUSSION

General Overview of Textbook Content

This research focuses on the geometry tasks in these two selected mathematics textbooks. Table 3 shows the scopes of geometry topics presented in the analyzed textbooks. The analysis was limited only to similar geometry topics which were covered in the two textbooks.

Table 4.

Geometry Topics in the Indonesian Textbook	Geometry Topics in the Laotian Textbook
Lines and Angles (Garis dan Sudut)	Rectangle, Triangle and Circle (ຮູບສີ່ແຈ, ຮູບສາມແຈ ແລະ ວົງມົນ)
Relations Between Lines (*Hubungan Antar Garis*)	Parallelogram (ຮູບສີ່ແຈຂ້າງຂະໜານ)
Dividing a Line Segment into Some Equal Sections (*Membagi Ruas Garis Menjadi Beberapa Bagian Sama*)	Rhombus and Square (ຮູບດອກຈັນ ແລະ ຮູບຈະຕຸລັດ)
Knowing about the Angle (*Mengenal Sudut*)	Trapezium (ຮູບຄາງໝູ)
Angular Relations (*Hubungan Antar Sudut*)	Triangle (ຮູບສາມແຈ)
Drawing the Special Angle (*Melukis Sudut Istimewa*)	The Important Line in Triangle (ເສັ້ນທີ່ສຳຄັນໃນຮູບສາມແຈ)
Triangle and Rectangle (*segitiga dan segiempat*)	The Perimeter and Area of Rectangle, Square, and Rhombus (ລວງຮອບ ແລະ ເນື້ອທີ່ຂອງ ຮູບສີ່ແຈສາກ, ຮູບຈະຕຸລັດ ແລະ ຮູບດອກຈັນ)
Knowing about the shape of Rectangle and Triangle (*Mengenal Bangun Datar Segiempat dan Segitiga*)	The Perimeter and Area of Parallelogram, Triangle and Triangle Trapezium (ລວງຮອບ ແລະ ເນື້ອທີ່ຂອງ ຮູບສີ່ແຈຂ້າງຂະໜານ, ຮູບສາມແຈ ແລະ ຮູບຄາງໝູ)
Dividing a Line Segment into Some Equal Sections (*Membagi Ruas Garis Menjadi Beberapa Bagian Sama*)	Angles in the Triangle (ມຸມໃນ ແລະ ມຸມ ນອກຂອງ ຮູບສາມແຈ)
Understanding the Perimeter and Area of Rectangle (Memahami Keliling dan Luas Segiempat)	Angles in the rectangle (ມຸມໃນຂອງຮູບສີ່ແຈສອດ)
Understanding the Types and the Shape of Triangle (*Memahami Jenis dan Sifat Segitiga*)	Circles (ວົງມົນ ແລະ ແຜ່ນມົນ)
Understanding the Perimeter and Area of Triangle (*Memahami Keliling dan Luas Segitiga*)	

Understanding important lines in the Triangle (*Memahami Garis-garis Istimewa pada Segitiga*)

Each topic in both the Laotian and Indonesian mathematic textbooks started with explanation information, followed by examples, and then exercises. The exercise was a collection of questions that students can use to practice their understanding or learning abilities. Therefore, the exercises in the two mathematic textbooks were analyzed and described based on Lower-Order Thinking Skills (LOTS) and High-Order Thinking Skills (HOTS) of revised Bloom's Taxonomy. From the similar topics in the two textbooks, all geometry tasks were analyzed by identifying the characteristics of the tasks from perspective of the Bloom's Taxonomy. The procedure has followed the analysis framework (see Table 1) to analyze the two selected textbooks by recording the geometry tasks and discuss each geometry question based on the indicator and definition of revised Bloom's Taxonomy such as remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5) and creating (C6).

The Geometry Tasks in Laotian and Indonesian Textbooks from the Perspective of the Revised Bloom's Taxonomy

The geometry tasks in the Indonesian and the Laotian mathematics textbooks were analyzed from the perspective of revised Bloom's Taxonomy, i.e. remembering (C1), understanding (C2), applying(C3), analyzing (C4), evaluating (C5), and creating (C6). The six cognitive levels domain of revised Bloom's Taxonomy consisted of C1, C2, C3 in LOTS, and C4, C5, C6 in HOTS. The geometry tasks in the two mathematic textbooks were analyzed from the perspective of revised Bloom's Taxonomy. The final results about the cognitive domain levels of revised Bloom's Taxonomy from geometry tasks in the Indonesian and the Laotian mathematics textbook grade VII displayed in Table 4 and Table 5 respectively.

Table 4. The geometry tasks in Indonesian mathematics textbooks from the perspective of revised Bloom's Taxonomy

Levels of Cognitive Domain			Frequency	Percentage
C1		Remembering	3	2.22%
C2	LOTS	Understanding	36	26.67%
C3		Applying	45	33.33%
C4		Analyzing	40	29.63%
C5	HOTS	Evaluating	7	5.19%
C6		Creating	4	2.96%
Total			**135**	**100%**

Table 4. The geometry tasks in Laotian mathematics textbooks from the perspective of revised Bloom's Taxonomy

Levels of Cognitive Domain			Frequency	Percentage
C1		Remembering	8	9.30%
C2	LOTS	Understanding	23	26.74%
C3		Applying	27	31.40%
C4		Analyzing	19	22.09%
C5	HOTS	Evaluating	9	10.47%
C6		Creating	0	0%
Total			**86**	**100%**

Based on the analysis results of geometry tasks in the Indonesian and the Laotian mathematics textbooks from the perspective of revised Bloom's Taxonomy above. It can conclude that both mathematics textbooks based revised Bloom's Taxonomy. The comparison of frequencies in the six levels of cognitive domain in the Indonesian and the Laotian grade VII mathematics textbook showed in Figure 1 below.

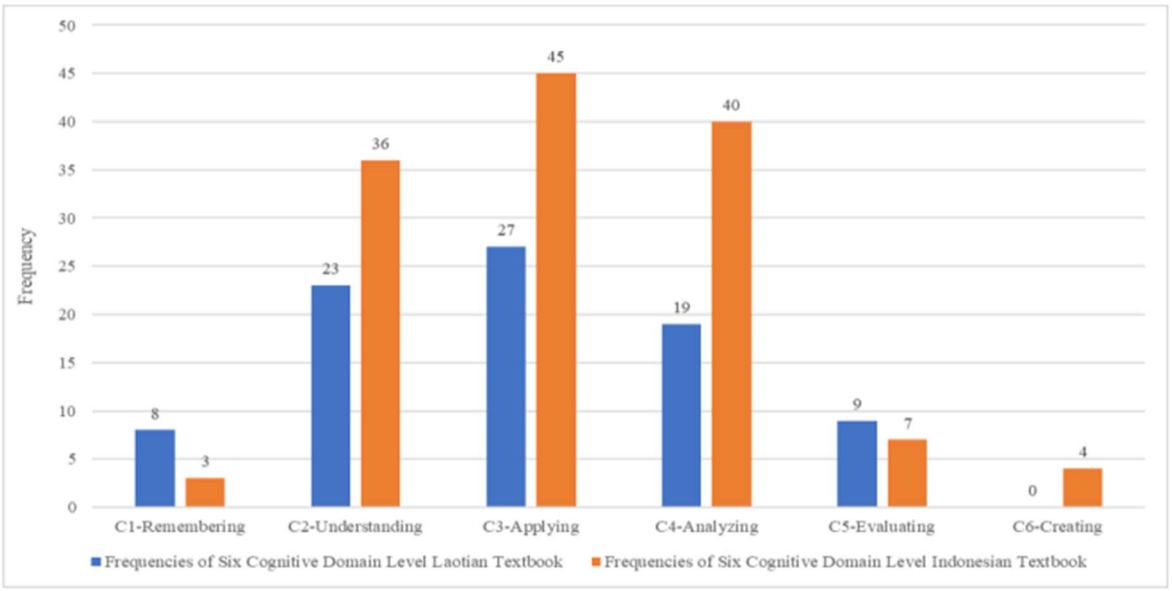

Figure 1. A comparison of frequencies of mathematics tasks in the six levels of Bloom's Taxonomy in the Indonesian and the Laotian Grade VII Mathematics Textbooks

Based on the frequencies analysis, the Indonesian grade VII mathematics textbooks has more geometry tasks (exercises) from the perspective of revised Bloom's Taxonomy than the Laotian mathematics textbooks for Understanding (C2), Applying (C3), Analyzing (C4) and Creating (C6). While the Laotian textbooks have higher frequency for Remembering (C1). Both mathematic textbooks have comparable frequency for Evaluating (C5). This result indicated that the Indonesian mathematic textbook has higher frequencies of geometry tasks in Lower Order-Thinking Skills (LOTS) "Understanding (C2) and Applying (C3)", and Higher Order-Thinking Skills (HOTS) consisting of "Analyzing (C4) and Creating (C6)" when compared to the Laotian mathematics textbooks.

Final Remarks

Textbooks could serve as important media to support students' learning because they are the main learning resources used by teachers and students to achieve curriculum goals (Pepin & Haggarty, 2001). Therefore, the textbooks used by students in learning should facilitate in LOTS and HOTS of revised Bloom's taxonomy. Because of this reason, it is important to know the Laotian geometry tasks in mathematics textbooks in terms of LOTS and HOTS comparing to Indonesian geometry tasks in textbooks since Indonesian students have high mathematic achievement comparing to most other southeast Asia countries. Therefore, the geometry tasks (exercises) in the two selected textbooks were analyzed and compared.

The grade VII Laotian and Indonesian mathematics textbooks were analyzed using a framework which has been developed based on revised Bloom's Taxonomy, in Remembering (C1), Understanding (C2), Applying (C3), Analyzing (C4), Evaluating (C5), and Creating (C6). The framework was adapted to the characteristics of the textbook tasks being analyzed. Analysis of the geometry tasks in the two textbooks using the six cognitive domain levels of revised Bloom's Taxonomy to calculate and compare the differences in term of frequency and percentages for each level. The researcher implemented the proportional stratified random sampling technique to generate a set of data for use in this study.

CONCLUSION

Textbooks serve as an essential media to support students' learning because they are the main learning resources used by teachers and students to achieve curriculum goals (Pepin & Haggarty, 2001). Therefore, the textbooks used by students in learning should facilitate in LOTS and HOTS of revised Bloom's taxonomy. Because of this reason, it is important to know the Laotian geometry tasks in

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In summary, this research showed that teaching and learning geometry tasks in Laotian mathematics textbooks appeared to rely more on memorization (Remembering) and less on C2 (Understanding) and C3 (Applying) in LOTS of revised Bloom's Taxonomy when compared to the geometry tasks in Indonesian mathematic textbook. In addition, the study also showed that lower frequency and percentages for Analyzing (C4) and Creating (C6) in the Laotian mathematics textbooks in HOTS of revised Bloom's Taxonomy.

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