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Identifikasi Soal dalam Buku Siswa Kurikulum 2013 berdasarkan Dimensi Kognitif dari *TIMSS*

Identification of Mathematics Questions in Student Books for Curriculum 2013 based on Cognitive Dimensions by TIMSS

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Abstract

TIMSS (Trends in International Mathematics and Science Study) study shows that Indonesia's mathematical problem-solving ability scores are below the average. This study aims to identify math problems in the 2013 grade VII curriculum students' books for even semesters based on the cognitive dimensions of TIMSS. This research is library research using a qualitative approach. The instrument in this study uses analytical guidelines based on the cognitive dimensions of the 2015 TIMSS, which consists of three domains, namely knowledge (knowing 35%), application (applying 40%), and reasoning (reasoning 25%). The results of the identification of 150 questions in which were identified obtained the level of the proportion of cognitive domains by the proportions tested in the TIMSS. The questions in the book have provided provisions for preparing and empowering students' thinking development to solve mathematical problems.

Keywords: *Cognitive Dimension; Mathematics Student Book; TIMSS 2015.*

Abstrak

TIMSS (Trends in Internasional Mathematics and Science Study) menunjukkan bahwa kemampuan pemecahan masalah matematika siswa Indonesia masih berada di bawah rata-rata. Penelitian ini bertujuan untuk mengidentifikasi soal matematika dalam buku siswa kurikulum 2013 kelas VII semester genap berdasarkan dimensi kognitif dari TIMSS. Penelitian ini bersifat kepustakaan dengan menggunakan pendekatan kualitatif. Instrumen dalam penelitian ini menggunakan pedoman analisis berdasarkan dimensi kognitif dari TIMSS 2015 yang terdiri atas tiga domain yaitu pengetahuan (knowing 35%), penerapan (applying 40%), dan penalaran (reasoning 25%). Hasil identifikasi dari 150 soal diperoleh tingkat proporsi domain kognitifnya sesuai dengan proporsi yang diuji dalam TIMSS. Soal-soal dalam buku tersebut sudah mampu memberikan bekal dalam mempersiapkan dan memberdayakan tingkat perkembangan berpikir siswa untuk memecahkan masalah matematika.

Kata Kunci: *Buku Siswa Matematika; Dimensi Kognitif; TIMSS 2015.*

Introduction

The use of mathematical concepts ranging from simple to complex calculations. It has become commonplace today that mathematics becomes available to learning at every school level. The goal of mathematics in schools is to help students prepare themselves to be able to deal with change and prepare students to be able to use mathematics in everyday life [1]. Students must also learn how to convey, reason, handle problems, connect thoughts, and think critically in handling and solving mathematical problems [2].

The ability to solve mathematical problems is a critical thinking process in dealing with mathematical problems by analyzing information and observing the process to find solutions to these problems [3]. One of the determinants of the success of the mathematics learning process is the ability of students to solve mathematical problems. In addition, the quality of the textbooks used can determine a factor for success in the learning process.

Textbooks are learning media that have the main task in the classroom, media for conveying material, as learning programs, and are fundamental and significant in encouraging, advancing, and educating students [4]. Textbooks used by students include learning materials that are arranged systematically with specific goals and questions that students can work on to prepare and practice student learning independence.

Learning textbooks can be a means of supporting effective and efficient learning in assessing student achievement [5]. With textbooks, it will maximize students' ability to understand the material being taught so that the learning process at school is more effective and efficient; in other words learning without the help of a teacher.

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[1] Andri Andri and Kusandi Kusandi, "Pengaruh Metode Pembelajaran Inkuiri Terbimbing Terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas IV Sekolah Dasar Negeri 27 Sintang Tahun Pelajaran 2016/2017," *VOX EDUKASI: Jurnal Ilmiah Ilmu Pendidikan* 7, no. 2 (2016): 100–110, https://doi.org/10.31932/ve.v7i2.68.

[2] Robby Suryana, "Efektivitas Model Discovery Learning Terhadap Kemampuan Berpikir Kritis Dan Kemampuan Pemecahan Masalah Matematika Siswa Kelas VIIII SMP Xaverius Lubuklinggau Tahun Pelajaran 2016/2017," *Lubuklinggau: Jurusan Pendidikan Matematika Dan Ilmu Pengetahuan Alam*, 2016.

[3] Muhamad Toyib, Nur Rohman, and Sri Sutarni, "Kemampuan Pemecahan Masalah Matematika Model TIMSS Konten Bilangan Pada Siswa dengan Kecerdasan Logis-Matematis Tinggi," *Kontinu: Jurnal Penelitian Didaktik Matematika* 3, no. 2 (November 19, 2019): 63–80, https://doi.org/10.30659/kontinu.3.2.63-80.

[4] Anwar Efendi, "Beberapa Catatan Tentang Buku Teks Pelajaran Di Sekolah," *INSANIA: Jurnal Pemikiran Alternatif Kependidikan* 14, no. 2 (October 1, 2015): 320–33, https://doi.org/10.24090/insania.v14i2.334.

[5] Apolonia Hendrice Ramda, "Analisis Kesesuaian Materi Buku Teks Kemendikbud Matematika Kelas VII dengan Kurikulum 2013," *Pythagoras: Jurnal Matematika dan Pendidikan Matematika* 12, no. 1 (June 4, 2017): 12–22, https://doi.org/10.21831/pg.v12i1.14057.

In general, the teacher presents practice questions in the textbooks used by students even though there are many other sources. Information about the nature of questions in textbooks is essential for teachers because it illustrates students' understanding of a material and trains students' thinking skills in solving problems. Likewise, questions with various difficulty levels can describe students' cognitive levels.

Since Indonesia participated in the TIMSS study in 1999, Indonesia is still in a below-average position [6]. The average result of Indonesia's achievement in TIMSS 2011 has the lowest percentage that can be achieved by students in the cognitive domain, namely at the reasoning level of 17% when compared to students' abilities at the knowing level of 37% and applying 23% [7]. While the average results of Indonesia's achievements in TIMSS 2015 consist of three domains, namely knowledge 35%, applying 40%, and reasoning 25% [8]. International Study Trends in International Mathematics This is a benchmark for the Science Study (TIMSS), an international study of trends or developments in science and mathematics carried out every four years by the International Association for the Evaluation of Education Achievement (IEA) [9]. TIMSS aims to measure the learning achievement of science and mathematics students in grade IV elementary schools and grade VIII junior high schools in various participating countries. The advantage Indonesia can get by participating is knowing the situation of Indonesian student achievement compared to student achievement in various countries and what components influence it [10].

TIMSS rates students through the content and cognitive dimensions. This dimension has the credibility of the material that is introduced in

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[6] Any Isroaty and Umi Farihah, "Analisis Soal Dalam Buku Siswa Matematika Kurikulum 2013 (Edisi Revisi 2017) Berdasarkan Dimensi Trends in International Mathematics and Science Study (TIMSS)," in *Prosiding Seminar Nasional Pendidikan Matematika*, vol. 1, 2019.

[7] Syamsul Hadi and Novaliyosi Novaliyosi, "TIMSS Indonesia (Trends in International Mathematics and Science Study)," in *Prosiding Seminar Nasional & Call For Papers* (Implementasi Riset Kuantitatif, Kualitatif, R&D, dan Mix Method pada Era Revolusi Industri 4.0, Tasikmalaya: FKIP Universitas Siliwangi, 2019), 562–69, https://jurnal.unsil.ac.id/index.php/sncp/article/view/1096/754.

[8] Anisa Arum Padmawati and Budi Murtiyasa, "Analisis Deskriptif Butir Soal Pada Buku Ajar Matematika Kelas IX Kurikulum 2013 Ditinjau Dari Aspek Kognitif Timss" (PhD Thesis, Universitas Muhammadiyah Surakarta, 2017).

[9] Hazlita Hazlita, Zulkardi Zulkardi, and Darmawijoyo Darmawijoyo, "Pengembangan Soal Penalaran Model TIMSS Konteks Sumatera Selatan Di Kelas IX SMP," *Kreano, Jurnal Matematika Kreatif-Inovatif* 5, no. 2 (October 9, 2015): 170–79, https://doi.org/10.15294/kreano.v5i2.3326.

[10] Dwi Cahya Sari, "Karakteristik Soal TIMSS" (Seminar Nasional Matematika dan Pendidikan Matematika, Yogyakarta: Universitas Negeri Yogyakarta, 2015), 303–8, http://seminar.uny.ac.id/semnasmatematika/sites/seminar.uny.ac.id.semnasmatematika/files/banner/PM-44.pdf.

learning. The cognitive dimension consists of 35% knowing domain, applying 40%, and 25% reasoning [11].

The math exercises contained in the TIMSS study can be a tool for measuring students' capacity levels, from knowing facts and honest thoughts to applying them to deal with various problems ranging from simple problems to problems requiring high analysis [12]. However, seeing the results of TIMSS and the condition of education in Indonesia, the government continues to make efforts to improve the current education system. One of them is by providing 2013 curriculum textbooks. The textbooks are compiled for implementing the 2013 curriculum, used as auxiliary materials for students in the learning process, and can also be used as teacher references. In addition, the student handbook with the theme of renewal and refinement in the 2013 curriculum is also relied on to make Indonesian people think inventively, usefully, creatively, proactively, and emotionally through improving perspectives and developing attitudes, skills and knowledge in an integrative manner so that it can fulfill the psychological, psychomotor, emotional points shown by the quality of mathematics itself [13].

TIMSS questions tested students' ability to know realistic ideas, methodologies, and their application in dealing with problems, starting from basic and straightforward thinking problems to problems with high levels of reasoning [14]. Therefore, the importance of the quality of practice questions in textbooks that teachers use is the focus of researchers to conduct research. The researcher interviewed mathematics teachers at MTs, Soppeng Regency, as a first step. In the interview, information was obtained that in learning mathematics, students used the book Mathematics-Study and Teaching for Class VII Semester 2 SMP/MTs (Revised Edition 2016) published by the Center for Curriculum and Books, Balitang, Ministry of Education and Culture. The teacher also provided information that the difficulty level of the textbook questions varied greatly. Starting from the difficulty level of low, medium, and very high. Students need help solving problems from mathematics textbooks with low difficulty levels. However, for questions with a high level of difficulty, students tend to ask for additional instructions from the teacher.

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[11] Lorent Agustina Arissanti and Zulkardi Zulkardi, "Analisis Soal-Soal Bilangan Pada Buku Teks Matematika Kurikulum 2013 Edisi 2017 Kelas VII Berdasarkan Framework" (undergraduate, Sriwijaya University, 2018), https://repository.unsri.ac.id/1726/.

[12] Budi Cahyono and Nurul Adilah, "Analisis Soal Dalam Buku Siswa Matematika Kurikulum 2013 Kelas VIII Semester I Berdasarkan Dimensi Kognitif Dari TIMSS," *Jurnal Review Pembelajaran Matematika* 1, no. 1 (2016): 86–98.

[13] Novi Dwi Cahyanti, "Analisis Aspek Kognitif TIMSS 2015 Soal Pada Buku Ajar Matematika Kelas VIII Kurikulum 2013" (Thesis, Surakarta, 2017), http://eprints.ums.ac.id/49420/1/NASKAH%20PUBLIKASI.pdf.

[14] Anisa Arum Padmawati, "Aspek Kognitif TIMSS Pada Soal Latihan Buku Ajar Matematika Kelas IX Kurikulum 2013" (Thesis, Surakarta, 2017), http://eprints.ums.ac.id/55803/1/01.NASKAH%20PUBLIKASI.pdf.

Yayuk Kuswanti, et al found that the composition of the questions in the class VII mathematics textbook (2014 revised edition) still needed closer to the goals to be achieved in the 2011 TIMSS study for the cognitive dimension. The application domain dominates competency test questions in the textbook. This textbook is because these questions do not provide a challenge in dealing with crucial issues that demand creativity, strategic planning, and logical thinking for students to solve problems. Meanwhile, decision-making skills, and creative and logical thinking are required to be able to compete in a global world [15].

Research by Takwatin Wahyuningsih shows that the percentage of cognitive level in simple problem-solving questions includes a knowledge level of 52.75%, an application level of 10.65%, and an analysis level of 6.70% [16]. Research conducted by Rosyita Anindyarini explained that the percentage of the proportion of cognitive aspects in books still has variations with the proportions determined by TIMSS 2015, where the knowledge aspect in books is still lacking at 6.86%, the application aspect is 0.39%, while the reasoning aspect exceeds 6, 96% [17]. Research conducted by Budi Cahyono showed that of the 212 questions analyzed, 36 questions only reached a cognitive level in the knowledge domain of 16.98%, 114 questions had reached a cognitive level in the applying domain of 53.77%, and 62 questions had reached a cognitive level in the applying domain. Domain reasoning 29.25%. The percentage of the cognitive domain contained in the questions in the student book and the scope of the cognitive domain do not match the proportion tested on the cognitive dimension in TIMSS.

However, the questions in the 2013 curriculum mathematics student book have provided provisions to train and encourage students' thinking development [18]. Research by Novi Dwi Cahyanti shows that the cognitive aspects of knowing are 24.31%, applying is 46.45%, and reasoning is 29.15%. This data shows that the book has provided reasoning questions that can familiarize students with thinking about solving problems that require

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[15] Yayuk Kuswanti, Susi Setiawani, and Nurcholif Diah Sri Lestari, "Analisis Soal Dalam Buku Siswa Matematika Kurikulum 2013 Untuk Sekolah Menengah Pertama Kelas VII Berdasarkan Dimensi Kognitif Trends International Mathematics and Science Study (TIMSS)," *Jurnal Edukasi* 4, no. 3 (2017): 25–29.

[16] Takwatin Wahyuningsih and Idris Harta, "Analisis Level Kognitif Soal–Soal Pemecahan Masalah Pada Buku Siswa Matematika Kelas VII Kurikulum 2013" (PhD Thesis, Universitas Muhammadiyah Surakarta, 2016).

[17] Rosyita Anindyarini, "Pemetaan Aspek Kognitif Soal Pada Buku Ajar Matematika SMP Kelas VII Kurikulum 2013 Edisi Revisi" (Thesis, Surakarta, 2017), http://eprints.ums.ac.id/49151/15/02.NASKAH%20PUBLIKASI.pdf.

[18] Cahyono and Adilah, "Analisis Soal Dalam Buku Siswa Matematika Kurikulum 2013 Kelas VIII Semester I Berdasarkan Dimensi Kognitif Dari TIMSS."

reasoning so that it is expected to contribute to the progress of Indonesian education [19].

Based on some of these studies and the facts obtained about the proportion of difficulty levels of questions in students' mathematics textbooks, the researcher tried to identify questions in the 2013 curriculum 2013 students' mathematics textbooks in even semesters based on the cognitive dimension of TIMSS. This dimension differs from previous research, which only identified the cognitive level. This study's results are expected to ease the burden on teachers, especially class VII teachers, in selecting questions based on students' cognitive dimensions.

Method

This research is a literature study that identifies questions in the 2013 curriculum 2013 class VII student's mathematics book even Semester. This research approach uses a qualitative approach. The location of this research is one of the schools in MTs. Regency. Soppeng. The source of the data used is the 2013 mathematics student book for grade VII even semester curriculum with the title Mathematics-Study and Teaching for SMP/MTs grade VII semester 2 (2016 Revised Edition), author by Abdur Rahman As'aridkk, Reviewer by Agus Lukitodkk, publishing supervisor by the Center for Curriculum and Books, Balitbang, Kemdikbud, year of publication 2016, place of publication in Jakarta, print III. This book consists of Comparisons (chapter 5), Social Arithmetic (chapter 6), Lines and Angles (chapter 7), Quadrilaterals and Triangles (chapter 8), and Data Presentation (chapter 9).

Data collection was carried out using documentation with research instruments using identification guidelines based on the cognitive dimensions of TIMSS 2015, which consisted of three domains: Knowledge 35%, Application 40%, and Reasoning 25%.

In this study, the data used descriptive analysis. The questions in the 2013 curriculum 2013 mathematics student book for class VII even Semester were identified based on the cognitive dimensions of TIMSS 2015 to understand the domains and cognitive aspects informed in the questions. The steps used to identify questions are data preparation, data depreciation, data presentation, and data checking.

Results and Discussions

Based on the identification results of the competency test questions for all chapters in the 2013 curriculum student book for class VII even semester, the percentage of cognitive domains is presented in table 1.

[19] Cahyanti, "Analisis Aspek Kognitif TIMSS 2015 Soal Pada Buku Ajar Matematika Kelas VIII Kurikulum 2013."

Table 1. The Percentage of Cognitive Domains in Books

No.	Chapter	Cognitive Domains			Number of Questions
		Knowledge	Application	Reasoning	
1.	Chapter 5	10%	40%	50%	150
2.	Chapter 6	3,45%	31,03%	65,52%	
3.	Chapter 7	20%	36,67%	43,33%	
4.	Chapter 8	10%	23,33%	66,67%	
5.	Chapter 9	53,33%	36,67%	10%	
Rata-rata		19,36%	33,54%	47,10%	

Source: Processed data

Based on the results of identifying all the questions in the competency test for each chapter in the 2013 class VII student mathematics learning book even Semester, an average cognitive level in the knowledge domain was 19.36% which was dominated by questions on data presentation material in chapter 9. The average cognitive level in the application domain is 33.54%, which is dominated by questions on comparative material in chapter 5. The average cognitive level in the reasoning domain is 47.10% which is dominated by questions on quadrilaterals and triangles in chapter 8. Therefore, all the questions in the 2013 even semester mathematics student learning book are generally questions that reach a cognitive level in the reasoning domain, namely questions that reasoning so that it encourage students to deal with problems with a higher level of thinking.

According to TIMSS 2015, the proportion of cognitive dimensions consists of 3 domains: knowledge 35%, application 40%, and reasoning 25%. Based on this, the proportion of math book questions for students in the 2013 curriculum for class VII even Semester does not match the proportion used in TIMSS for the cognitive dimension. The reasoning domain far exceeds the proportion tested in TIMSS, while the knowledge and application domain has yet to reach the proportion tested in TIMSS.

In line with the research conducted by Rosyita, it shows that in textbooks, the proportion of knowledge (Knowing) is 28.14%, applying domain is 39.61%, and the reasoning domain is 31.96%. Even though the results of his research are in contrast to the results of this study, there is still a big difference in the proportions of questions between the proportions of cognitive aspects in the book and TIMSS 2015 [20].

Overall, questions that reach the cognitive level with the highest percentage in the student's book for the knowledge domain are in chapter 9 data presentation material, with 53.33%. The information found in chapter 9 presents data in bar, line, and circle charts, deciding on data in the form of

[20] Anindyarini, "Pemetaan Aspek Kognitif Soal Pada Buku Ajar Matematika SMP Kelas VII Kurikulum 2013 Edisi Revisi."

bar, line, and circle charts. The dominant types of questions in the knowledge domain in this chapter are the types of questions whose solutions take information or elements known to have been presented in tables, graphs, or other simple sources. There are several examples of questions at the cognitive level for the knowledge domain in chapter 9, one of which is competency test question 9, number 11.

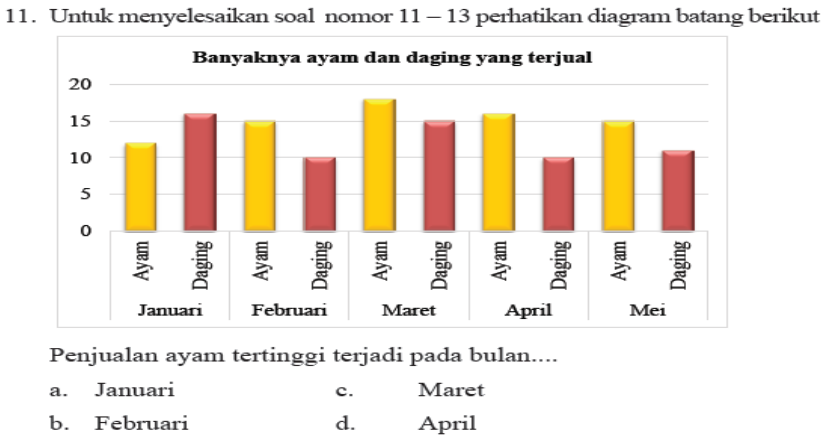


Figure 1. Data presentation material questions

Figure 1 question, including the domain of knowledge because it contains aspects of cognitive retrieval. The standard cognitive retrieve aspect of this question is that students can make decisions or information from a bar chart that shows the number of chickens and meat sold in a few months to produce one final answer choice.

Furthermore, questions that arrive at the cognitive level with the highest percentage in the student book for the applying domain are in chapter 5 comparative material with a percentage of 40%. Information that can be found in chapter 5 is recognizing and understanding various approaches to number comparisons, solving problems with ratios, percentages, and fractions, determining unit rates, and using rates, rates, and speed to create tables and equations, using ratios and proportions to handle various problems. The dominant types of questions in the applying domain in this chapter are the types of questions that are solved by applying mathematical concepts. There are several examples of questions at the cognitive level for the application domain in chapter 5, one of which is the competency test question in chapter 5, number 2.

2. Rasio waktu yang diluangkan Karina untuk mengerjakan tugas Matematika terhadap tugas IPA adalah 5 banding 4. Jika dia meluangkan 40 menit untuk menyelesaikan tugas Matematika, maka waktu yang dia luangkan untuk menyelesaikan tugas IPA adalah ...

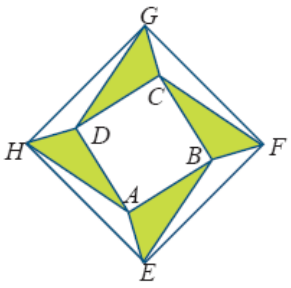
a. 20 menit
b. 32 menit
c. 60 menit
d. 90 menit

Figure 2. Comparison Material Questions

Figure 2 questions, including the implementation domain, because it contains implement cognitive aspects for the standard cognitive aspects of implementation on this question. Students apply the concept of comparison of worth to determine the time spent on completing science assignments. Applying the concept of equivalent comparison is a way that is determined and needed to solve problems in the problem.

Finally, the questions that arrive at the cognitive level with the highest percentage in the student's book for the reasoning domain are in chapter 8 on quadrilaterals and triangles, with 66.67%. The information found in chapter 8 is various kinds of quadrilaterals and triangles, differences in regular quadrilaterals, irregular quadrilaterals, quadrilaterals and non-squares, formulas and perimeters of quadrilaterals and triangles, and drawing memorable lines on triangles. The dominant types of questions in the reasoning domain in this chapter are types of questions that require the evaluation of alternative problem-solving strategies and problem-solving solutions. There are several examples of questions at the cognitive level for the domain of reasoning in chapter 8, one of which is the competency test question in chapter 8, number 17.

17. Gambar di bawah ini, ΔABE, ΔBCF, ΔCDG, dan ΔADH memiliki bentuk dan ukuran yang sama. Luas persegi $ABCD$ sama dengan jumlah luas daerah yang diarsir. Jika luas $ABCD = 2M$, maka luas $EFGH$ adalah ....



a. 2 M
b. 4 M
c. 6 M
d. 8 M

Figure 3. Questions about Quadrilaterals and Triangles

Question picture 3 includes the domain of reasoning because it contains evaluates cognitive aspects. The legal aspect of cognitive evaluation is that students can evaluate or consider the procedures to solve problems. The procedure used is to find and form congruent triangles, then apply the concept of the area of a triangle.

Questions in the 2013 Mathematics Student Book for Grade VII Even Semester have prepared and empowered students' thinking development. This can be seen from the percentage of the reasoning domain, which is higher than the percentage of knowing and applying to the questions. Even though the reasoning domain is more emphasized in this book, to solve problems at the reasoning level, students need to apply mathematical knowledge, which includes concepts, facts, procedures, and an understanding of mathematical concepts to produce representational abilities, where the ideas represent the ability—furthermore, the core of the ability to think and communicate mathematically. Furthermore, students are also required to use logic and systematic thinking skills, including intuitive and inductive reasoning based on patterns that can be used to solve new and non-familiar problems[21].

Conclusions

The results of the identification of the cognitive level of all questions in the competency test for each chapter in the 2013 class VII mathematics student book even Semester based on the cognitive dimensions of TIMSS 2015 were obtained from 150 questions, the cognitive level in the knowledge domain was 19.36%, the cognitive level in the applying domain was 33.54 %, and cognitive level in the reasoning domain 47.10%. This proportion does not match the proportion used in TIMSS for the cognitive dimension. However, the questions in the book have provided provisions for preparing and empowering students' level of thinking development to solve math problems.

Based on these results, it is suggested that authors of mathematics books for the school level to consider the proportion of cognitive dimensions used by TIMSS. This supports the teacher's efforts to identify students' cognitive abilities based on the dimensions put forward by the TIMSS. This research can still be developed by analyzing several sources of junior and senior high school student mathematics books.

[21] Sari, "Karakteristik Soal TIMSS."

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