The Profile Of Elementary School Students' Ability In Mathematical Reasoning

Noening Andrijati, Djemari Mardapi, Heri Retnawati

Abstract: The insuffiency of information regarding the achievements associated with the students' mathematical abilities and the different implementations of educational curriculums in elementary schools becomes the reason to pursue this research. The article is aimed at describing mathematical abilities of fourth-grade elementary school students in accord with the national curriculums applied in Indonesia, which are the School-based and the 2013 Curriculum. The data were collected from 200 fourth-grade elementary school students in Tegal City, Central Java Province. Specifically, the elementary schools involved in this research use either the School-based Curriculum or the 2013 Curriculum. As the research instrument, a test was developed based on the TIMSS assessment design and adjusted in Indonesian context, consisting of twelve items. The descriptions of the data were presented quantitatively. Based on the results, it is found that mathematical reasoning abilities of fourth-grade elementary school students in Tegal city fall into low and intermediate categories. It is also found that the students meet with significan difficulties in all content domains administered to them, especially in the domain of data display. There is tendency in which fourth-grade elementary school students who learn through the 2013 Curriculum show better mathematical reasoning abilities than who learn through the School-based Curriculum.

Keywords: fourth-grade, elementary school, the school-based curriculum, the 2013 curriculum

1 INTRODUCTION

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has launched a global campaign known as "Literacy for All",declaring that every person in the world has the absolute right to be literate through which he or she can be empowered to overcome challenges and succeed in life.Literacy can be defined as an essential skill to process information, identify and understand certain problems, and make decisions to solve the problems.Literacy, specifically in schools, includes three aspects: reading literacy, mathematics literacy, and science literacy.In connection with mathematics education, literacy can be viewed as the students'fundamental competencies in mathematics, in which they are able to put the concepts of mathematics they have learned into everyday use (Ojose, 2011: 91). Literacy skills of Indonesian students can be generally observed from the results of Indonesia's participation in several international comparative studies, such as studies promoted by Programme for International Student Assessment (PISA) dan Trends in International Mathematics and Science Studies (TIMSS). PISA was first performed in 2000 and repeated every three year. Its aim is to evaluate educational systems by measuring 15-year-old students' literacy skills in reading, mathematics and science.In 2000, it was found that the mathematics achievement score of 15-year-old Indonesian students was lower than the standardized international average score (500), and thus Indonesia ranked 39th among the 41 participant countries.The relatively similar results were also obtained in PISA conducted in 2003 and 2006, in which the mathematics achievement score of 15-year-old Indonesian students respectively ranked 38th among the 40 participant countries and 50th among the 57 participant countries (Puspendik, 2012b).

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In PISA conducted in 2012,the mathematics achievement score of Indonesian students revealed an even more alarming result, ranking 64th among the 65 participant countries. Meanwhile, Vietnamese students achieved the average mathematics score of 511 which was undoubtedly higher than the average mathematics score of 375 achieved by Indonesian students (OECD, 2013). The mathematics literacy achievement of Indonesian students can also be observed from the results of TIMSS' studies. TIMSS is an international program administered every four year, established to evaluate the development of 13-year-old students' knowledge and skills in mathematics and science. In Indonesia, these 13-year-old students can specifically refer to the first-grade junior high school or Madrasah Tsanawiyah (islamic junior high school) students. According the results of the studies conducted by TIMSS, the mathematical knowledge and skills of Indonesian first-grade junior high school and Madrasah Tsanawiyah students hasn't showed achievements as satisfying as expected. In TIMSS conducted in 1999 and 2003, Indonesian students worryingly ranked 34th among the 38 participant countries and 35th among the 46 participant countries respectively.Next in 2007, Indonesian students' achievement score of mathematics literacy was still stuck in a low rank, which was the 36th among the 49 participant countries (Puspendik, 2012a). TIMSS in 2011 also showed a relatively similar result which was published by the National Institute of Research and Development of the Ministry of Education and Culture (Badan Penelitian dan Pengembangan Kemendikbud, 2013), in which Indonesian students ranked 38th among the 42 participant countries. According to the results of TIMSS' studies in 2011,the mathematics literacy of Indonesian first-grade junior high school (SMP) and Madrasah Tsanawiyah students could only achieve the average score of 386. It was surely lower than the standardized score of low international benchmark which was of 400. Regarding cognitive domains, the mathematics achievement of Indonesian students was reported at 37% in the knowing aspect, 23% in the applying aspect, and 17% in the reasoning aspect.In other words, it can be said that Indonesian students' mathematics literacy in the reasoning aspect is the weakest compared to the other two aspects.According to Mullis et al. (2011), mathematical reasoning involves skills to think logically and systematically. Furthermore, it includes intuitive reasoning (spontaneity) and inductive reasoning (the ability to draw conclusions) based on patterns and regularities as methods to find solutions to non-routine problems. Non-routine problems are the kind of problems probably very unfamiliar to students, which can be in the forms of mathematics items administered to them or exposure to real conditions as in everyday life. As then stated by Mullis et al. (2011), the domains related to mathematical reasoning are the skills to analyze, to generalize/ specialize/synthesize, to justify, and to solve non-routine problems. Furthermore, Koenig (2007) suggested that reasoning and proofing activities in instruction programs from pre-kindergarten to senior high school level include the following steps: (1) recognizing reasoning and evidence as basic aspects of mathematics; (2) making and investigating conjecture in mathematics; (3) developing and evaluating arguments in mathematics; and (4) selecting and using various kinds of reasoning and proving methods. The low achievement scores of mathematics literacy showed by Indonesian students in both PISA and TIMSS can be caused by several factors. One of the factors is the undeniable fact that Indonesian students are less skilled atcontextually solving mathematical problems which requires their abilities to reason, argue and demonstrate creativity to succeed, as characterized by TIMSS' mathematics items.The findings of a research conducted by Iryanti (2010) reveal that the percentage of the allocated time for mathematics learning in Indonesia where students are administered with low-complexity mathematics items is the highest. It was reported at 57%, while moderate-complexity mathematics items reached 40% of the allocated time and high-complexity mathematics items reached only 3% of the allocated time.Unfortunately, TIMSS' mathematics items consist of mathematical problems ranging from moderate to high complexity. In summary, the time allocated for mathematics learning in Indonesian schools is still mostly spent to solve mathematical problems which can be categorized as relatively easy. The low achievement of Indonesian junior high school and Madrasah Tsanawiyah students in mathematical reasoning may be caused by an internal factor, which is the previous competency of mathematical reasoning when they were in elementary schools.According to the findings of a research conducted by Watts, et al. (2016: 8 & 11), there are indications that mathematical skills demonstrated by children from the preschool stage to the first year at elementary schoolscan predict their mathematics achievement in a positive and significant wayuntil they reach the age of fifteen or enter senior high schools.This statement highlights the likelihood that the mathematical knowledge and skills showed by students in elementary schools will be reflected in the development of their abilitieswhen they later enter junior high schools, senior high schools and the next higher levels.Therefore, it can be said thatthe mathematical abilitiesof students at the junior high school level are directly affected by their prior mathematical abilitiesat the elementary school level. TIMSS assessed students' mathematical abilities through two dimensions, namely content domain and cognitive domain. The content domain was in line with the material in the content standard, for first-grade junior high school includes number, algebra, geometric shape & measurement, data display and probability. Meanwhile, the content domain for elementary school include number (50%), geometric shape & measurement (35%), and data display (15%). The cognitive domain is related to the students' thinking process consisting of knowing facts and procedures, using a concept, and solving routine problem and reasoning. The reasoning is the expected behavior of students when dealing with mathematical domains that it was contained in the content domain.The mathematics achievement of Indonesian fourth-grade elementary school students in TIMSS 2015 was placed in the low category. The achievement score was 397, unfortunately lower than the low international benchmark of 400. With this result, it can be interpreted that Indonesian elementary school students generally have some basic mathematical knowledge. They can add and substract whole numbers, have some understanding of multiplication by one-digit numbers, and can solve simple word problems. They have some knowledge of simple fractions, geometric shapes, and measurement. They can read and complete simple bar graphs and tables (Mullis, et.al., 2016: 19). According to the achievement results for the TIMSS mathematics content domains, Indonesian elementary school students reach 24% in the content domain of number, 28% in the content domain of geometric shapes and measurement, and 31% in the content domain of data display. Meanwhile, the achievement results for the cognitive domains reveal that Indonesian elementary school students reach 32% for the knowing domain, 24% for the applying domain, and 20% for the reasoning domain. All components of mathematics achievement in the content domains show almost similar results. However, in the cognitive domains, it can be seen that Indonesian elementary school students show the lowest achievement for mathematical reasoning, and alarmingly the result is far below the international average which should be at 47% (Mullis et al., 2016: 211). This indicates that Indonesian elementary school students still have poor mathematical knowledge and skills both in content and cognitive aspects. Related specifically to mathematical abilities in the cognitive domains, it can be considered that Indonesian elementary school students suffer from the lack of capabilities to solve non-routine problems in situations unfamiliar to them, where they are exposed to various complex contexts and required to conduct multi-step procedures. It is known that educational comparative studies involved in TIMSS employ standardized assessment instruments intended for international purposes.In fact, those assessment instruments do not incorporate particular contextsprevailing in a particular country. Real-life contexts in Indonesia, for instance.A number of terms of places or events unfamiliar to Indonesian students can be found in the TIMSS assessment items, such as "subway"(Mahdiansyah & Rahmawati, 2014: 453), names of cities, and kinds of sport or games. Meanwhile, real-life contexts embodied in the assessment items areconsidered potentially able to influence the results achieved by the students. Contexts do play important roles as they can help guide students' ways of thinking, allowing them to connect a particular problem they are dealing with to its context and then formulate a particular solution to the problem in accord with the given context (Mahdiansyah & Rahmawati, 2014: 453). Stacey

(2011) also emphasizes the importance of contexts in learning and assessments. Students are prepared through education to overcome future challenges, so they must be introduced to a variety of real contexts which includes many different aspects of life. Due to the importance of contexts and the lack of studies regarding the use of assessment instruments for mathematical knowledge and skills specifically with Indonesian contexts, it is thus necessary to start promoting and conducting more studies which use assessment instruments with Indonesian contexts.
In elementary school, the abstract objects of mathematics should be modified to be more concrete such that the students can be imagine through a contextual problems (Swanson & Williams, 2014). According to Saleh, et.al (2018), the students can give response and solution algorithm formally and informally when they are engaged in the contextual problems. The learning sequence done by a students to reach the goal may vary from one student to the others. However, the teachers have to consider between the development stage of students' thinking process and the stage based on the mathematics structure. Therefore, students have to understand mathematics by not only memorizing it but also by providing broader opportunities to think of various problem understanding. Since 2013, the Indonesian Government has been implementing two curriculums of education, which are the School-based Curriculum (Kurikulum Tingkat Satuan Pendidikan/KTSP) and the 2013 Curriculum (Kurikulum 2013/K13). The implementation of these two curriculums has showndifferent effects in terms of emphases, process standards and learning assessments.The School-based Curriculum focuses on the knowledge aspect of learning, while the 2013 Curriculum focuses on the balance of softskills and hardskills which incorporate aspects of behavioral attributes, knowledge and skills. The standards for a learning process in the School-based Curriculum lie on explorative, elaborative, and confirmative activities.A learning process in the 2013 Curriculum, in contrast,involves scientific approaches in which the learning process standards embracea wider scope of activities where the students are allowed to observe, ask, synthesize, present, conclude and create.The School-based Curriculum places the importance of learning on the aspect of knowledge, so learning assessments are consequently oriented to the aspect of knowledge.In comparison to the School-based Curriculum, the 2013 Curriculum works on authentic assessments in which students' competencies are comprehensively measured including aspects of behavioral attributes, knowledge and skills. Now with the different characteristics of the two national curriculums, it can be seen that the 2013 Curriculum provideswider spaces and more opportunities for mathematics learning, especially in the attempt to develop students' mathematical reasoning abilities where it is hoped that they are able to think creatively and critically. Based on the background of this research, the questions to be pursued are: (a) what is the profile of elementary school students' matemathical reasoning abilities?; and (b) are there differences in the elementary school students' mathematical reasoning abilitiesin relation to the different national curriculums which are implemented in Indonesia? The purposes of this research are then to: (a) to obtain information about the profile of elementary school students' matemathical reasoning abilities, (b) to obtain information if there are any differences regarding mathematical reasoning abilities between Indonesian elementary school students who are educated through the School-based Curriculum and Indonesian elementary school students who are educated through the 2013 Curriculum. The results of this research are expected to provide information for other scholars, researchers, and policy makers, so they can have deep understanding of mathematical reasoning abilities which the students need to develop for the betterment of education systems in Indonesia.

2 METHODS

Research approach
This study was using a qualitative approach. Qualitative descriptive technique was selected to describe how the profiles of elementary school students' reasoning abilities in solving mathematical problems with the TIMSS test design. Besides that, it is also used to find out whether or not there are differences in reasoning ability according to the two curriculums applied, namely the 2013 curriculum and School-based curriculum.

Population and Sample
In this research, the population was all students of the fourth-grade elementary school in the second semester of the school year 2017/2018 in Tegal City, Central Java province. Next, the selected samples of this study were 200 students, consisting of 128 students from 4 elementary schools which use the 2013 Curriculum in learning (i.e. Mangkukusuman 8, Mangkukusuman 4, Al Irsyad, and Kejambon 2) and 72 students from 3 elementary schools which use the School-based Curriculum in learning (i.e. Tegalsari 4, Debong Lor 2, and Kalinyamat Kulon 1).

Data Collection
The data were collected through a testing technique,where the selected samples were administered with twelve items of mathematical reasoning adopted from the TIMSS assessment instruments. They were in the form of essays which had been adapted to real-life contexts in Indonesia in terms of language, names of places or kinds of events. The essay items comprised of 6 items in the content domain of number (50%), 4 items in the content domain of geometric shapes and measurement (33%), and 2 items in the content domain of data display (17%). This test had been theoretically validated by twoexperts in mathematics education and measurement, and an elementary school teacher as apractitioner. The test was then tried out on 60 elementary school students excluding the selected samples. The data taken from the results of theempirical try-out were analyzed using item response theory with the QUEST program to identify the characteristics of the items and the overall test. The results of the try-out data analysis revealed that the item difficulty level was within the range -1,58 – 1,50 which could be categorized as good, the discriminating power was in the range 0,17 – 0,64 which could be categorized as good, and the reliability coefficient of the test was 0,87 which could becategorized as high.With these results, it was concluded that the test had fulfilled all the requirements to be a good test. Next, the test was administered to the selected samples and the scores

gained from the test were tabulated.The students' answers were then marked with the scale score of 2 for a correct and complete answer, the scale score of 1 for a correct but incomplete answer, and the scale score of 0 for a wrong answer or no answer.

Data anaysis

The results of the mathematical reasoning ability test were analyzed descriptively and quantitatively.The descriptive quantitative analysis was done by converting the scoresgained from the test into achievement scores with the following formulation:

$$\text{Achievement score} = \left(\frac{\text{Gained scores}}{\text{Maximum}} \quad \text{x } 700 \right) + \quad 100$$

The achievement scores gained from the test results were then described according to the following categories:

Table 1. *Categories of Students' Mathematical Abilities*
Based on the TIMSS Assessment Method

Achievement Score	*Category*
625 – 800	*Advanced*
550 – 624	*High*
475 – 549	*Intermediate*
100 – 474	*Low*

A comparative analysis was then conducted to identify and describe the results. The results of the mathematical reasoning test of the students educated through the 2013 Curriculum were contrasted to the results of the mathematical reasoning test of the students educated through the School-based Curriculum.

3 FINDINGS

In this research, mathematical reasoning abilities of the students are revealed by the valued results of the 12-item mathematical reasoning test administered to them. During the assessment process, it was found that there were relatively many students who wrote down their answers without giving any specific explanations or procedures in solving the problems. These conditions show that the students were less capable of giving their explanations or delivering their arguments related to the answers they wrote down.The achievement representing students' mathematical reasoning abilities based on the content domains and the analysis results from the procedure of comparing students educated through the School-based Curriculum with students educated through the 2013 Curriculum are presented and described below.

Mathematical Reasoning Abilities

Mathematical reasoning abilities quantitatively shown by scored test results reveal the factthat the students' average achievement score is 465,75 and it can be categorizedas low. In detail, there is only 10% of the selected students who got achievement scores higher than 625 and thus they can be categorized as students with advanced mathematicalreasoning abilities, while 13% of them are students with high mathematical reasoning abilities, 24% of them are students with intermediate mathematical reasoning abilities, and 53% of them are students with low mathematical reasoning abilities.

Table 2. *The Percentage of Students' Mathematical Reasoning Abilities*
Based on the TIMSS Assessment Method

Achievement Score	*Category*	*Percentage (%)*
625 – 800	*Advanced*	*10*
550 – 624	*High*	*13*
475 – 549	*Intermediate*	*24*
100 – 474	*Low*	*53*
Total		*100*

The data regarding students' mathematical reasoning abilities are also classified based on the content domains and presented as following.

Table 3. *Students' Mathematical Reasoning Abilities*
Based on the Content Domains

Contents	*Average Achievement Score*	*Category*
Domain of Number	*467,50*	*Low*
Domain of Geometric Shapes and Measures	*486,75*	*Intermediate*
Domain of Data Display	*418,50*	*Low*

The data on Table 3.describes that the average score of geometric shape and measurement content was 486.75 in the medium category, while the the average score data for number and data display content were 467. 50 and 418.50 respectively in the low category. Differences of Students' Mathematical Reasoning Abilities Based on the Implemented CurriculumsA comparative analysis was conducted to identify any potential differences of mathematical reasoning abilities between students who are educated through the School-based Curriculum and students who are educated through the 2013 Curriculum. The analyzed data were in the form of raw scores gained from the results of the 12-item mathematical reasoning test, in which 0 is the lowest score and 24 is the highest score. The results of the descriptive analysis on the raw scores in the scale range from 0 to 24 reveal that the average test score for mathematical reasoning abilities of the students with the 2013 Curriculum is 14,19, while the average test score for mathematical reasoning abilities of the students with the School-based Curriculum is 11,39. This means that the average test score for mathematical reasoning abilities of the students with the 2013 Curriculum is 2.8 points higher than the average test score for mathematical reasoning abilities of the students with the School-based Curriculum. In the following table are presented the details about the students' average achievement scores for all content domains and each domain (number, geometric shapes and measurement, and data display) based on the implemented curriculums.

Table 4. *The Comparison of Students' Average Achievement Scores Regarding Mathematical Reasoning Abilities Based on the Implemented Curriculums*

Content Domains	*Average Achievement Score*		*Relation*
	2013	*School-based (M_2)*	

	(M_1)		
Number	*498.31*	*412.73*	$M_1>M_2$
Geometric Shapes and Measurement	*495.80*	*470.66*	$M_1>M_2$
Data Display	*421.29*	*413.54*	$M_1>M_2$
Overall	*471.80*	*432.31*	$M_1>M_2$

The students' average achievement scores for all content domains and each domain being thoroughly observed, it can be said thatthe scores for mathematical reasoning abilities of the students educated through the 2013 Curriculum are higher than the students educated through the School-based Curriculum. With this result, it is obvious that there is a tendency for better mathematical abilitiesto be owned and performed by students with the 2013 Curriculum than students with the School-based Curriculum.

4 DISCUSSION AND CONCLUSIONS

Discussion

Mathematical ability (reasoning) of students overall is in the low category. This condition illustrates that students have some basic mathematical knowledge. They can add and subtract whole numbers, have some understanding of multiplication by one-digit numbers, and can solve simple word problems. They have some knowledge of simple fractions, geometric shapes, and measurement. Students can read and complete simple bar graphs and tables ((Mullis, et. al, 2016: 67) In detailed from Table 2, the achievement of students' reasoning abilities according to the TIMSS assessment benchmarks are as follows: 10% of students are in the advanced category; 13% of students in the high category; 24% of students in the intermediate category, and 53% of students in the low category. This achievement explains that: (1) 10% of students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can solve a variety of multi-step word problems involving whole numbers. Students at this level show an increasing understanding of fractions and decimals. They can apply knowledge of a range of two-and three-dimensional shapes in a variety of situations. They can interpret and represent data to solve multi-step problems; (2) 12% of students can apply their knowledge and understanding to solve problems. They can solve word problems involving operations with whole numbers, simple fractions, and two-place decimals. Students demonstrate understanding of geometric properties of shapes and of angles that are less than or greater than a right angle. Students can interpret and use data in tables and a variety of graphs to solve problems; (3) 25% of students can apply basic mathematical knowledge in simple situations. They demonstrate an understanding of whole numbers and some understanding of fractions and decimals. Students can relate two-and three-dimensional shapes and identify and draw shapes with simples properties. They can read and interpret bar graphs and tables; and (4) 53% of students have some basic mathematics knowledge. They can add and subtract whole numbers, have some understanding of multiplication by one-digit numbers, and can solve simple word problems. They have some knowledge of simple fractions, geometric shapes, and measurement. Students can read and complete simple bar graphs and tables (Mullis, et. al, 2016: 67). The table 3. above has clearly revealed the students' average achievement scores gained from the mathematical reasoning ability test, in which students have an intermediate average achievement score in the domain of geometric shapes and measures and low average achievement scores in the domains of number and data display. These low and intermediate results indicate that the students generally still have poor mathematical reasoning abilities. The reasoning ability of students on the content of number in low category illustrates that the students have ability to add and substract whole numbers, have some understanding of multiplication by one-digit numbers, and can solve simple word problems, and have some knowledge of simple fractions. The achievement of students' reasoning abilities in the content of geometric shapes and measurements in the intermediate category indicates that the students have ability to relate two- and three-dimensional shapes and identify and draw shapes with simple properties. Meanwhile, the students' reasoning ability on the data display in the low category shows that new students have the abilityread and complete simple bar graphs and tables (Mullis, et. al, 2016: 67). These findings indicate that students are less capable of solving the problems adopted from the TIMSS assessment design, even when real-life contexts in Indonesia are used. Besides that, the researchers also assume that the test is difficult for them because the designs of the test items are different from the ones they have been familiar with. In this case, the test items involve non-routine problems. The test items makecognitive demands over and above those needed for solution of routine problems, even when the knowledge and the skills required for their solution have been learned (Mullis et al., 2003; Kolouv, et al., 2009) It can also be seen that the lowest average achievement score is in the domain of data display. The students educated through the School-based Curriculum met with difficulties in solving the test items regarding data display which, in actual fact, are relatively easy. This can be understood with the fact that the concepts of data display have not been learned yet in the fifth grade with this curriculum. Importantly, it must be noted that the students educated through the 2013 Curriculum also met with similar difficulties. Even though they have got the concepts of data display, the concepts are merely introductory and very simple, such as putting data into a table or reading data in a table. The scores for mathematical reasoning abilities of the students educated through the 2013 Curriculum are higher than the students educated through the School-based Curriculum. These differences can be caused by the fact that the 2013 Curriculum have been implemented quite betterin Indonesian elementary schools if compared to the School-based Curriculum. The 2013 Curriculum is known tointegrate scientific approaches into learning processes. These learning processes involve activities where the students are encouraged to actively participate in observing objects of learning, asking questions, pursuing information, associating ideas with real experiences, and communicating their opinions.In this way, the procedures of learning place the emphasis on the significance of inductive reasoning. Based on observations, even though mathematics as a science was abstract and deductive, teachers in elementary schools taught mathematics through concrete and inductive ways. The teacher generalized by observing concrete objects and examples and through inductive conclusions. This phenomenon supports the Kurnik (2008: 421) stated that teaching in primary schools was mostly concrete and inductive. The mathematics teacher makes abstract conclusions by manipulating concrete objects and through inductive reasoning. This method or method is familiar and suitable for elementary students. Meanwhile, an inductive procedure consists of a series of inductive steps that lead to general understanding. Teachers who teach mathematics was made abstract conclusions by manipulating concrete objects and through inductive reasoning. This method was familiar and suitable for elementary school students. Meanwhile, an inductive procedure consists of a series of inductive steps that lead to general understanding. The teachers are responsible to apply hierarchical methods of learning which are in accordance with stages of scientific methods. They are allowed to observe the development of students' learning abilities and identify if students show slow development or meet with difficulties in learning, and they therefore can quickly make decisions about what to fix and improve when problems occur.The 2013 Curriculum provides the opportunities for the students to develop themselves in the aspects of behavioral attributes, knowledge and skills through various meaningful learning activities.They are able to independently construct their knowledge and improve their skills. This kind of learning processescorresponds to the viewpointof Varelas and Ford (2008: 31), that the implementation of scientific approaches will enable teachers and curriculum developers to improve learning processes by breaking the processes down into steps or stages in detail which contains instructions for the students to do learning activities. Besides that, assessments for learning in the 2013 Curriculum are characteristically authentic and comprehensive, encompassing all dimensions of assessments. Instruments used in the assessments are also adjusted to the learning activities being carried out, so they can effectively measure the processes of learning and the results of the students' works.

5 CONCLUSIONS

Based on the results of data analysis and the previous discussion, it can be concluded that: (a) the achievements for mathematical reasoning abilities of the elementary school students who are involved as the selected samples in this research can be categorized as intermediate in the domain of geometric shapes and measurement, and low in the domain of number and data display. Their mathematical abilities were measured using a test adapted from the TIMSS assessment design. The test was arranged and developed according to real-life contexts in Indonesia in terms of languages, names of places, and kinds of events. Answers given for the test items which were lack of specific explanations and calculation procedures indicate that the students are less capable of giving their explanations or delivering their arguments for the problems being administered to them to solve; (b) there is a tendency for better mathematical reasoning abilities to be owned and performed by elementary school students in Tegal who are educated through the 2013 Curriculum than students who are educated through the School-based Curriculum. This research has its limitations, especially regarding the descriptions for the achievements of mathematical reasoning abilities of elementary school students in Tegal who were tested using the TIMSS assessment design. Therefore, further researches are needed to deepen and widen the scope of research, such as by studying with other mathematical abilities, expanding the area of research, or studying factors which influence students' mathematical reasoning abilities. Besides that, it is also hoped that teachers are able to plan and develop learning activities and assessments which improve students' mathematical reasoning abilities, including the steps or stages where the students are made familiar with mathematical reasoning tests, particularly with tests designed for an international scale like TIMSS.

6 REFERENCES

[1] Badan Penelitian dan Pengembangan Kemendikbud, (2013) Laporan Studi Kajian Peserta Didik pada Tingkat Dasar. Jakarta: Badan Penelitian dan Pengembangan.

[2] Iryanti, P., (2010). Potret pengajaran matematika SMP kelas 8 Indonesia. Jurnal Edukasi Matematika, 1(2): 36 – 43.

[3] Koenig, G. (2007). Orchard Software and The NCTM Principles and Standards for School Mathematics. Reston: Siboney Learning Group

[4] Kurnik, Z. 2008. The Scientific Approach to Teaching Math. Metodika, 17: 421-432.

[5] Kolouv, et al., (2009). Non-routine Problem-Solving Tasks in Primary School Mathematics Textbook-A Needle in a Haystack. Mediterranean Journal for Research in Mathematics Educatio, 8(2): 31-68.

[6] Mahdiansyah & Rahmawati, (2014) Literasi Matematika Siswa Pendidikan Menengah: Analisis Menggunakan Desain Tes Internasional dengan Konteks Indonesia. Jurnal Dikbud, 20 (4): 452 – 469.

[7] Mullis, et al., (2003). TIMSS Assessment Frameworks and Specifications 2003 (2nd edition). Chestnut Hill, MA: Boston College.

[8] Mullis, et al, (2012) TIMSS 2011 Assessment Framework. Chestnut Hill, MA: Boston College.

[9] Mullis, et al., (2016). TIMSS 2015 Results in Mathematics. Chestnut Hill, MA: Boston College.

[10] OECD, (2013). PISA 2012 Results: What Students Know and Can Do: Students Performance in Mathematics, Reading, and Science. Paris: OECD Publishing.

[11] Ojose, B., Mathematics Literacy: Are We Able To Put The Mathematics We Learn Into Every Day Use?. Journal of Mathematics Education, 5 (1): 89-100.

[12] Pusat Penilaian Pendidikan Balitbang Kemendikbud, (2012a) . Determinants of Learning Outomes TIMSS 2011: Final Report. Jakarta: Puspendik.

[13] Pusat Penilaian Pendidikan Balitbang Kemendikbud, (2012b). Kemampuan Membaca Siswa Kelas IV Sekolah Dasar di Provinsi Kalimantan Timur dan D.I.Yogyakarta. Jakarta: Puspendik

[14] Pusat Penilaian Pendidikan Balitbang Kemendikbud, (2013b). Laporan Kompetensi Guru Dan Prestasi Siswa sebagai Dampak Dana Bantuan Langsung BERMUTU kepada KKG/MGMP. Jakarta: Puspendik.
[15] Rosnawati, R., (2013). Kemampuan Penalaran Matematika Siswa SMP Indonesia pada TIMSS 2011. Prosiding Seminar Nasional Penelitian Pendidikan dan Terapan MIPA, May: 1-6
[16] Saleh, et al., (2018). Improving the reasoning ability of elementary school student through the Indonesian Realistic Mathematics Education. Journal on Mathematics Education, 2018(9), 41-54
[17] Stacey, K., (2011). The PISA View of Mathematical Literacy in Indonesia". IndoMS, J.M.E. 2(2): 95 – 126
[18] Swanson, D. & William, J. (2014). Making abstract mathematics concrete in and out of school. Educational Studies in Mathematics, 86(2): 193-209
[19] UNESCO. Literacy for All. (undated). [Online]. Viewed 12 April 2016. Available: http//en.unesco.org/themes/literacy-all.
[20] Watts, et al., (2014). What's Past is Prologue: Relation Between Early Mathematics Knowledge and High School Achievement". Educ.Res. Author manuscript. 43(7): 352-360.