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Dear Editor of PEC,
We resubmit our article, after we have revised in many parts, suitable with the reviewers' comments.
Thanks.

Best Regards,

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TEACHERS' KNOWLEDGE TOWARDS HIGHER-ORDER THINKING SKILL AND ITS LEARNING STRATEGY

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Abstract

Higher order thinking skill (HOTS) is one of the students' abilities that should be developed through teaching and learning. The teachers' knowledge towards HOTS and its teaching and learning strategy become the key for successful teaching and learning. The research purposes to describe teachers' knowledge towards higher order thinking skill (HOTS). The research is qualitative study in phenomenological approach. The research participants are 25 mathematics teachers of state and private junior high schools in 6 provinces in Indonesia. The data were obtained from test followed by focus group discussion (FGD) and interviews. The data were analyzed using Bogdan & Biklen model, while test data were analyzed using descriptive analysis. The analysis of FGD, and test were performed to obtain information on 6 sub-themes; teachers' knowledge towards HOTS, the importance of HOTS, teaching HOTS to students, improving students' HOTS, measuring and assessing HOTS, and teachers' ability in solving HOTS questions. The results reveal that teachers' knowledge towards HOTS, teachers' ability in improving students' HOTS, solving HOTS problems, and measuring students's HOTS are still low. Results, however, indicate that teachers already have a good knowledge of the importance of HOTS and teaching HOTS using various innovative learning models.

Key words: *HOTS, teachers' knowledge, teaching and learning, measurement and assessment*

Introduction

Education is one of the important aspects affecting the future of a nation. The successful in education implementation is a key for future success. That achievement cannot be obtained without the role of various parties. Government, as a policy maker, has a role and responsibility to determine the path to success, while ensuring education equality throughout the nations, for example, free education policy in developing countries (Quamruzzaman, Rodríguez, Heymann, Kaufman, & Nandi, 2014). Aside the government's role, teachers also play an important role in education implementation considering their role as practicioners of the policies and regulations.

Education quality is not only determined by the plan and the development of education, but also determined by the quality of its implementation. It also requires control from various parties, such as education experts, education practitioners, and stakeholders. All of them must synergize to achieve educational success. It means that it not only focuses on the improvement of evaluation, curriculum changing, and creating new regulations, but also on the development of teacher professionalism (Purnomo, 2017). Some research revealed that teachers have already contributed in improving education quality in many countries (Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017; Hu, Fan, Yang, & Neitzel, 2017; Stylianides, 2007). Therefore, the quality of teacher in implementing education policy affects the quality of education.

The efforts to improve the quality of education cannot be separated from the demands of 21st Century competitiveness which is complex and challenging. There are 3 main frameworks of 21st century skills: 1) learning and innovation skills, 2) life and career skills, and 3) information, media, and technology skills (Scott, 2017). Learning and innovation skills consist of communication skills, collaboration skills, critical thinking skills, and creativity (4CS). Life and career skills consist of flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, leadership, and responsibility. Furthermore, information, media, and technology skills consist of information and media literacy. In addition, Bialik (2015) mentioned four key issues

in the 21st century education implementation framework: knowledge, skill, character, and metacognition.

Related to skill, Bialik (2015) and Scott (2017) mentioned that it has relevance to the 4CS competence, which includes creativity, critical thinking, communication, and collaboration. Scott (2017) and Bialik (2015) stated that the 21st century skills presented by can be grouped into two main components: abstract skills related to thinking skills (creative thinking and critical thinking), and concrete skills (communication and collaboration). Furthermore, creative thinking skills and critical thinking skills are included in higher-order thinking skill (HOTS) (Miri, David, & Uri, 2007; Moseley, Baumfield, Elliott, Gregson, Higgins, & Newton, 2005).

HOTS is one of the important components for an individual to be able to solve new problems in the 21st century (Brookhart, 2010; Moseley et al., 2005; Thompson, 2008). HOTS also plays an important role in applying, connecting, or manipulating the prior knowledge to solve new problems effectively (Thomas & Thorne, 2009). In revised Bloom's taxonomy, HOTS is defined as an incision between the top 3 levels of ability in the cognitive dimension (analyzing, evaluating, creating), and 3 levels of knowledge dimensions (conceptual, procedural, metacognitive) (Anderson & Krathwohl, 2001, Thompson, 2008). Therefore, HOTS is measured using tasks that include analyzing, evaluating, and creating conceptual knowledge, procedural knowledge, or metacognitive. It means that familiarizing students with HOTS activity is important to help students prepare themselves for solving new issues, adjusting to a new atmosphere, and making decisions about a particular problem.

In the implementation of learning, HOTS cannot be directly taught to students. HOTS, as a skill, must be trained to students through learning activities that support the HOTS development. Active learning and students-centered learning are activities that can train HOTS (Akyol & Garrison, 2011; Limbach & Waugh, 2010). The active learning and students-centered learning such as problem-based learning (PBL) (Mokhtar, Tarmizi, Job, & Nawawi, 2013), project-based learning (PjBL) (Vidergor & Krupnik-Gottlieb, 2015), discovery learning, and inquiry-based leaning (Orlich, Harder, Callahan, Trevisan, & Brown, 2010), or other learning models using contextual problems are some examples of strategies for training students' HOTS. In addition, Protheroe (Goethals, 2013) and Miri, David, and Uri (2007) mentioned that group discussion and solving complex and interdiciplinary problems in learning process are the important activties in training students' HOTS.

The outcome of students' HOTS development can be achieved by the active role of teachers in planning, implementing, and evaluating HOTS-oriented learning. To be able to plan HOTS-oriented learning, teachers need knowledge of ways, strategies, methods to train HOTS to students (Bartell, 2012). Some research results, however, indicate that mathematics teachers face some difficulties, particularly in implementing learning to train HOTS to students. The obstacles encountered include the difficulty of developing HOTS-based problems and developing learning tools (Jailani & Retnawati, 2016; Retnawati, Munadi, Arlinwibowo, Wulandari, & Sulistyaningsih, 2017; Thompson, 2008), as well as the difficulties in evaluating students' HOTS (Retnawati, Hadi, & Nugraha, 2016). Various obstacles also implicates the low-level of students' HOTS. Students' difficulty is also seen in students' ability in solving mathematics problems in national exam using contextual problem and narration (Retnawati, Kartowagiran, Arlinwibowo, & Sulistyaningsih, 2017).

Problem of Research

Based on the description, the assessment of teachers' knowledge of HOTS and its learning strategies still need to be conducted. Throughout this research, it is expected to get a broad picture of teachers' knowledge of HOTS and its learning strategy. These information assisted in planning programs that can improve teachers' knowledge of HOTS and its learning strategy. Therefore, this

study aims to describe teachers' knowledge towards HOTS and its teaching strategy in mathematics classroom.

The Researchers' Role

In this research, the researcher's relationships with participants were only to collecting and exploring data by performing test, focus group discussion (FGD), and interviews related to teacher knowledge towards HOTS. These results are then analyzed to gain an understanding. The researcher did not undertake any treatment to the participants in relation to the teacher's knowledge and mathematics teaching and learning strategies implemented by the teachers in the classroom.

Methodology of Research

The Type of Research

This research is a qualitative study in the phenomenological approach. It is conducted to explore teachers' knowledge of HOTS and their teaching strategy in mathematics classroom.

The Research Participants

The research participants was 25 mathematics teachers (14 female, 11 male; T1-T25) from 12 private Junior High Schools and 13 state Junior High Schools from 6 provinces in Indonesia. They are selected randomly. All of teachers have been taught mathematics exceed 10 years in Junior High School. They haven't participated in training about HOTS and its teaching and learning strategy.

Instrument and Procedures

The teachers were asked to complete a test and followed by Focus Group Discussion (FGD) and in-depth interviews to get deeper information. The test consist of 2 constructed response items that adapted from PISA released items. The two items had been validated by two mathematics education experts. The FGD and interviews topics consist of six sub-themes: 1) teachers' knowledge on HOTS, 2) the importance of HOTS, 3) learning strategy in implementing HOTS, 4) improving students' HOTS, 5) measuring and assessing HOTS, and 6) teachers' ability in solving HOTS problems. The test was also administered to measure teachers' HOTS by giving them HOTS problems in Figure 1.

Data Analysis

The data of FGD and interviews were analysed and presented into a table to be classified into sub-themes. The analysis of FGD data were conducted using Bogdan and Biklen model (1982) in order to know the relationship between sub-themes, whereas teachers' answers in solving HOTS problems were analyzed using descriptive analysis.

Ethical Considerations

At the beginning of the FGD and interviews, the researcher informed the participants that this study would only capture the knowledge of teachers towards HOTS and its teaching and learning strategy. The FGD and interviews conducted naturally to obtains credible information. The

teachers' names are also kept and for the purposes of research their identities are encoded, to ensure their answers have no effect on their professions as teachers.

1. Magazine Subscription

Geo-Picture magazine monthly subscription:

Geo-Picture Magazine Category	Price List
Geo-Picture Indonesia	Rp50.000,00
Geo-Picture Traveler	Rp45.000,00
Geo-Picture for Kids	Rp20.000,00

The magazine also offers annual subscription packages. If you subscribe at least two magazines in a year, you will get the discounts which are listed below:

Geo-Picture Magazine Category			Price List
Geo-Picture Indonesia	Geo-Picture Traveler	Geo-Picture for Kids	
✓	✓		Rp600.000,00
✓	✓	✓	Rp600.000,00
		✓	Rp444.000,00
✓	✓	✓	Rp804.000,00

If Rudi wants to subscribe the magazines, which one is the cheapest package that should be choosen by Rudi? Explain!

2. Dice game

Two players threw a dice. From the dice number that appears, the larger dice number is reduced by the smaller dice number. If the difference is 0, 1, or 2 then player A gets 1 point. However, if the difference is 3, 4, or 5 then player B gets 1 point. The game ends after 12 dice and the player with the most points is the winner. Is the game fair? If the game were unfair, how would the rules be changed to make the game fair?

Figure 1. The test to measure teachers' abillity in solving HOTS problems

Results of Research

Result gives information about teacher's perceptions towards mathematics learning to improve HOTS. Teachers' perception is classified into teachers' knowledge on HOTS, teachers' knowledge the importance of HOTS, teachers' knowledge on learning strategy in implementing HOTS, teachers' knowledge on improving students' HOTS, teachers' knowledge on measuring and assessing HOTS, and teachers' ability in solving HOTS problems. Every sub-theme is explained below.

Teachers' Knowledge towards HOTS

The results of data analysis and data reduction of teachers' knowledge towards HOTS show that teachers' knowledge of HOTS is still low. Some explanations given by teachers about HOTS are still general. In fact, there are many teachers who still have not been able to distinguish between HOTS and its strategies or learning methods. The analysis result can be seen in Table 1. Result shows that some teachers have explained HOTS using the top three levels of revised Bloom's taxonomy (analyzing, evaluating, and creating) while others using critical thinking skill, creativity, problem solving, logic, reflective, and metacognitive. Based on the FGD result, it shows that new teachers are able to understand conceptual knowledge, but unable to explain the operational

knowledge properly. Based on teachers' responses, it can be concluded that not all teachers understand HOTS well. Teachers still cannot differentiate between abilities, skill, learning methods or learning activities. Although the term of HOTS has often been encountered in teacher training activities and socialization of Curriculum 2013, teachers still unable to understand the definition of HOTS.

Table 1. Teachers' Knowledge of HOTS Definition

Definition of HOTS according to Mathematics Teachers	Verification Result
1. Learning stage that requires mastery of the correct concept 2. Thinking skill that is more than just memorizing and reading 3. High cognitive processes, such as analysing, evaluating, and creating 4. Thinking ability through understanding, observing, exploring, and inferring data 5. Critical thinking skill, creativity, logic, problem solving, and metacognitive 6. Learning process which includes knowledge, skill, and analysis 7. High level problem solving ability 8. Problem analysis skill 9. Learning methods which are not just solving the problem but needed a high understanding 10. Ability to solve problems with many steps.	Not all teachers understand HOTS well. Teachers stll unable to distinguish HOTS as an ability, skill, learning strategy, learning method, or learning process

Teachers' Knowledge on the Importance of HOTS

The results of data analysis and data reduction of teachers' knowledge on the importance of HOTS are explained in Table 2. According to teachers' response in second sub-theme depicts that most of the teachers said that HOTS is important because of its advantages in solving problems; problems can be vary and complex; therefore, HOTS-oriented learning is very important applied in learning process in order to solve daily life problems.

Table 2. Teachers' Knowledge on the Importance of HOTS

The Importance of HOTS	Verification Result
1. In learning mathematics, students are demanded not only mastering concept but also possessing problem solving skill 2. To train students' thinking skill and problem-solving skill 3. The learning process must be coherent, such as analysing problem and evaluating 4. Students can think and solve problems in difficult levels carefully 5. To train students critical thinking 6. High-order thinking skill cannot be separated from the cognitive elements of critical thinking skill, creativity, problem solving, logic, reflective, and metacognitive 7. Students need knowledge, skill, and analysis skill in solving problem that might be faced in daily life 8. HOTS is required to solve problem 9. Students not only encounter routine problems, but also unexpected problem (non- routine problem) 10. Students can study easily by using HOTS	Most teachers have realized the importance of HOTS for students, i.e. improving students' skill in solving problems including daily life problems

Other responses also show the importance of HOTS, because it makes students easier to learn. Responses also reveal that some teachers still give arguments about the importance of HOTS. They stated that HOTS is used to train children to think critically (T5). Based on the teachers' responses, it can be concluded that teachers already know the importance of HOTS. The awareness of the importance of HOTS is shown by the majority of respondents.

Teachers' Knowledge on Implementing HOTS in Learning

On the third sub-theme, teachers are asked to explain the strategies to teach HOTS. In this sub-theme, teachers are expected to describe learning model that can be used to teach HOTS to students on learning mathematics. The results of data analysis and data reduction of teachers' knowledge on implementing HOTS in learning can be seen in Table 3.

Table 3. Teachers' Knowledge on Implementing HOTS in Learning

Teachers' Knowledge on Implementing HOTS in Learning	Verification Result
1. Learning atmosphere should be fun, mastery of basic concepts must be strong, the use of small groups, habituation using HOTS questions, developing perseverance and curious attitude 2. Using problem solving approach and giving analysis question 3. Teaching student to analyse, evaluate, and create systematically 4. Training students to use complex questions and articullate problem, and ask them to find an answer and its procedure. 5. Providing problems related to daily problems 6. Applying problem solving approach 7. Students are given problems or HOTS question 8. From understanding, identifying problems, determining formulas, and solving problems 9. Students are given PISA questions 10. Applying problem- based learning, project- based learning, active learning, inquiry learning, and cooperative learning	Teachers know that teaching HOTS can be conducted using various learning models. Teachers are able to mention a number of learning models that can facilitate or teach HOTS

Results show that teachers' knowledge on teaching HOTS shows a positive impact. The results also show that teachers know that training students' HOTS can be conducted using various learning models. The results also indicate that teachers already know that teaching HOTS to students can be conducted by learning activities containing problem-solving activities. In addition, teachers response also show their knowledge about problem-based learning, project-based learning, active learning, inquiry learning, and cooperative learning.

Teachers' Knowledge on Improving Students' HOTS

The results of data analysis and data reduction of teachers' knowledge on improving students' HOTS can be seen in Table 4. In this sub-theme, teachers are asked to explain the learning activities which can improve students' HOTS. Teachers' response indicate that teachers still cannot explain how to improve students' HOTS, either conceptually or operationally.

Teachers' answeres indicate the teachers' misunderstanding about the operational implementation of learning activities to train HOTS. Most of the given answers is still normative, such as "ask students to think critically", "training students' thinking skill continously", and "training students by asking questions, creating group discussion, giving analysis (C4) or evaluation (C5) questions", eventhough the expected response is teachers explains activities which can improve HOTS.

Table 4. Teachers' Knowledge on Improving Students' HOTS

Teacher's Knowledge on Improving Students' HOTS	Verification Result
1. Learning habituation and mentoring 2. Practice by asking questions, creating discussion groups, giving C4 or C5 questions 3. Make a game, followed by increasing the level of thinking 4. Train by providing questions that contain high-level thinking processes 5. Application of problem-based learning model 6. Design methods, techniques, or approaches which can improve HOTS 7. Give students problems from low to high levels 8. Provide problems to students from easy to difficult levels 9. Students are required to read more HOTS literacy 10. Read a lot of reference books and exchange knowledge, methods, or knowledge with friends 11. Ask students to think critically	Most teachers still cannot explain how to improve students' HOTS, either conceptually or operationally.

Teachers' Knowledge on Measuring and Assessing HOTS

The results of data analysis and data reduction of teachers' knowledge on measuring and assessing HOTS can be seen in Table 5. Responses indicate that most of teachers has known how to measure and assess HOTS, such as giving a description, confirming through observation and presentation, and scoring.

Table 5. Teachers' Knowledge on Measuring and Assessing HOTS

How to Measure and Assess HOTS	Verification Result
1. Conducting interview to some students on the difficulty level of HOTS problems 2. Measuring students' understanding on solving problmes, constructing and finding solutions, and evaluting 3. Observing the effort of students in thinking and solving their problem by themselves 4. Analysisng students' answers especially in the process completing the answers 5. Using written assessment and observation 6. Conducting assessment of the process and final evaluation. Developing an instrument measuring high-level skill 7. Using essay, assessing the process in finding solution and stating final solution, interviewing students or assessing students presentation 8. Giving continuous problem and observing the improvement 9. Giving essay using daily life problems 10. Using assessment sheet, essay test, open ended problems	Most teachers already know various instrument to assess HOTS, such as essay, observation of problem-solving process, confirmation through observation and presentation, and scoring system.

The results explain that teachers have already known about various instruments used in measuring HOTS such as essay using contextual problems. Other responses explain techniques for assessing procedures which are not assessing the outcome only. These results indicate that teachers already know the instruments and how to measure HOTS conceptually. These responses, however, only explain the assessment process regarding to problem solving steps, none of which explain how to measure or assess HOTS using Bloom's taxonomy.

Teachers' Ability on Answering HOTS Problem

In this study, teacher was asked to answer some questions regarding to HOTS problem in order to find out teachers' HOTS. The examples of teachers' answers in solving the first HOTS problem are listed below.

> "The cheapest package is the fourth package, because if the normal price in a year subscription is calculated, the first package price reduces Rp540.000,00, the second package price reduces Rp240.000,00, the third package price reduces Rp336.000,00, the fourth package price reduces Rp576.000,00" (T1)
>
> "The packages that should be chosen are Geo-Picture Indonesia and Geo-Picture Traveler which is only for Rp600.000,00 because the subscription price of each magazine is cheaper than Geo-Picture for Kids" (T2)
>
> "I will choose Geo-Picture Indonesia, Geo-Picture Traveler, and Geo-Picture for Kids for Rp804.000,00 because they has the biggest discount" (T3)
>
> "I will choose 3 books in first package, because if the price is accumulated, it has more discount" (T4)
>
> "I will choose Geo-Picture Indonesia and Geo-Picture Traveler package, because the discount is bigger than other packages" (Teacher 5)

Of the five answers, the right answer is the answer from Teacher 1. Teacher 1 solves the problem of "Magazine Subscription" systimatically. He identifies important information by analysing, investigating, solving problems (creating), evaluating and drawing conclusions. His work in solving the problem is presented in Figure 2.

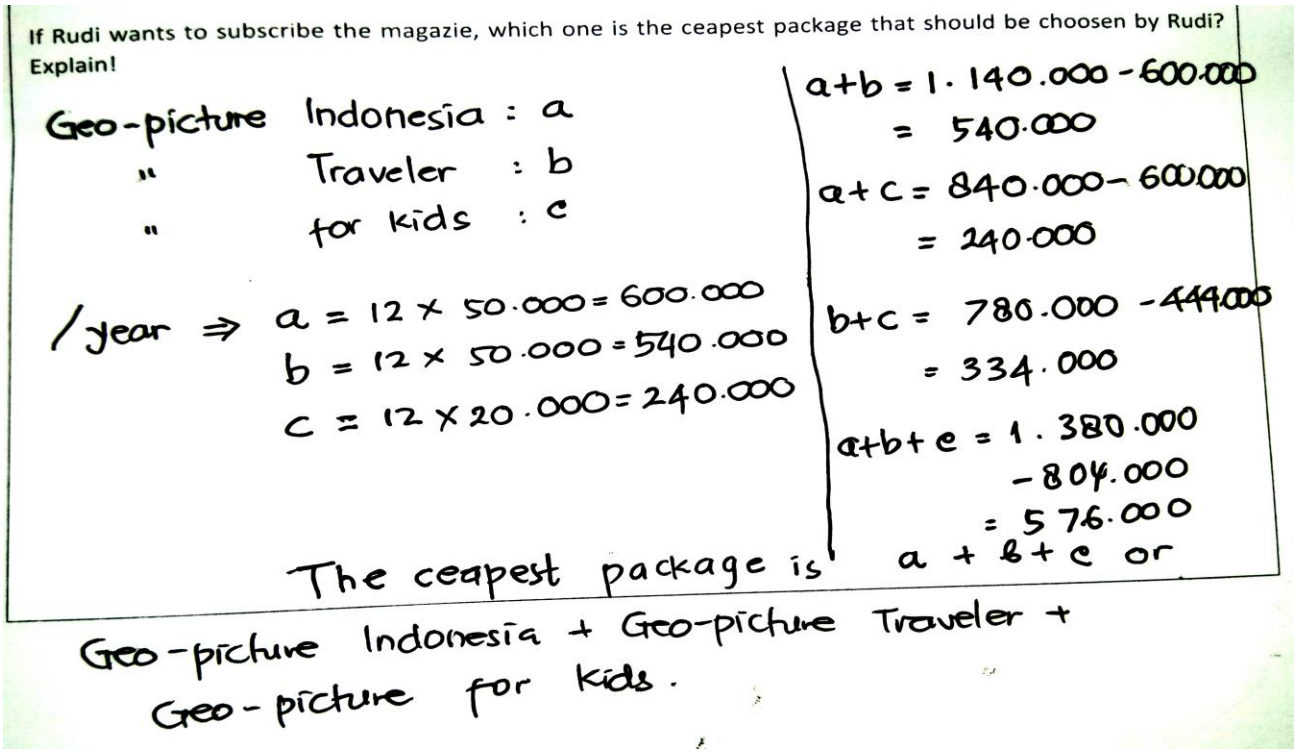

Figure 2. Teacher 1's Answer

Figure 2 is an example of the correct answer. Teacher 1 solves the problem by sparating each magazine. Then, he determines the price of each magazine in a year, then determines the amount of discount for each package. After that, he takes the decision by considering the biggest discount. Therefore, according to Teacher 1, the cheapest package that should be chosen by Rudi is the fourth

package. Teacher 3 and Teacher 4 actually have the correct answer, but their answers are not completed by the problem solving process. Figure 3 depicts Teacher 3's work in solving the problem.

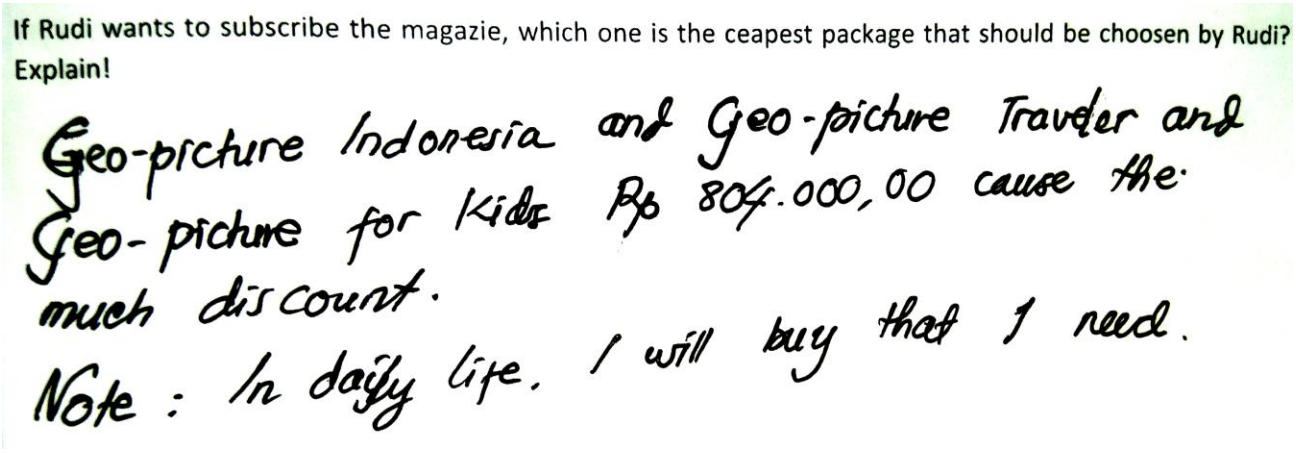

Figure 3. Teacher 3's Answer

Figure 3 is an example of the correct answer but not completed by a clear and detailed completion process. It can be seen in Figure 3 that Teacher 3 chose the fourth package because of its discount. The discount referred by Teacher 2, however, is not included in the drawing conclusion process. It shows that Teacher 2's understanding is still partial in solving the HOTS problem. Meanwhile, teacher 2 and teacher 5 gave different answers from three other teachers. Teacher 2 selected the second package because of its comparison price of each magazine, whereas teacher 5 preferred the first package because of its price. Figure 4 illustrates the Teacher 2's work in solving the problem.

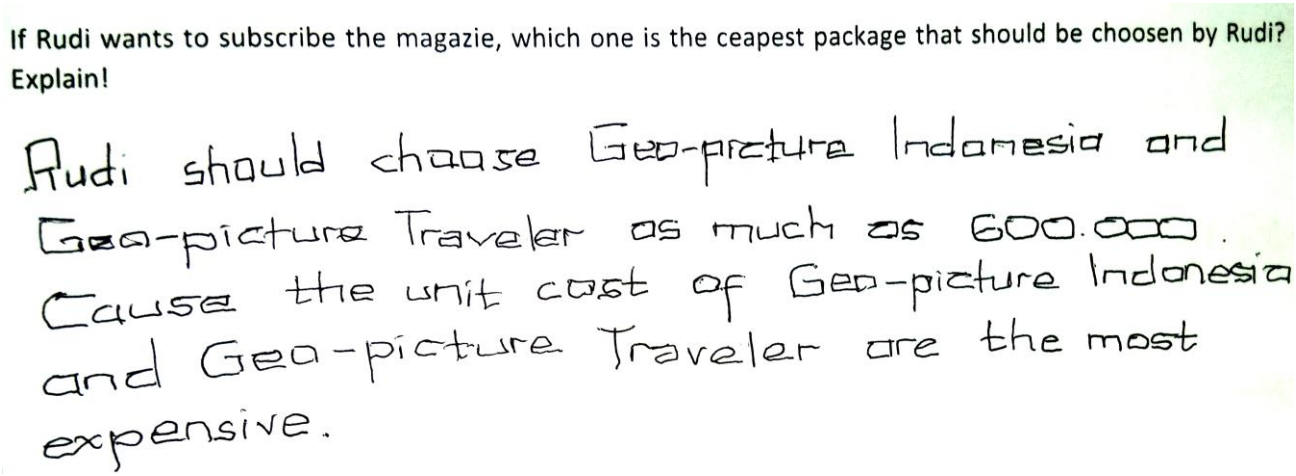

Figure 4. Teacher 2's Answer

Figure 4 is an example of the wrong answer. The mistake of teacher 2's answer lies in the drawing conclusion process. The drawing conclusions process is not accompanied by a clear completion process. Teacher 2 selected the first package (Geo-Picture Indonesia and Geo-Picture Traveler) because the price of each magazine in the package is the most expensive compared to each price of the Geo-Picture Traveler. The reason given by Teacher 2, however, is not appropriate to answer the question. There are two possibilities that cause teachers to give wrong answers. First,

teacher does not understand the question. Second, teacher does not understand discount concept. Therefore, it can be concluded that Teacher 2's skill to solve the HOTS problem is still low.

In the second HOTS problem, the teachers' answer are vary. The sample of them are listed below.

"In my opinon, the game is fair" (T7, T9, without reason)

"Probability of A and B are the same, equal to ½" (T15, without answer fair or not fair)

"The game is not fair, because the probability of A and B are different." (T20, T24)

The answers of T7, T9, and T15 are wrong answer, and the answers of T20 and T24 are partially true. The true answer is from T25, in Figure 5.

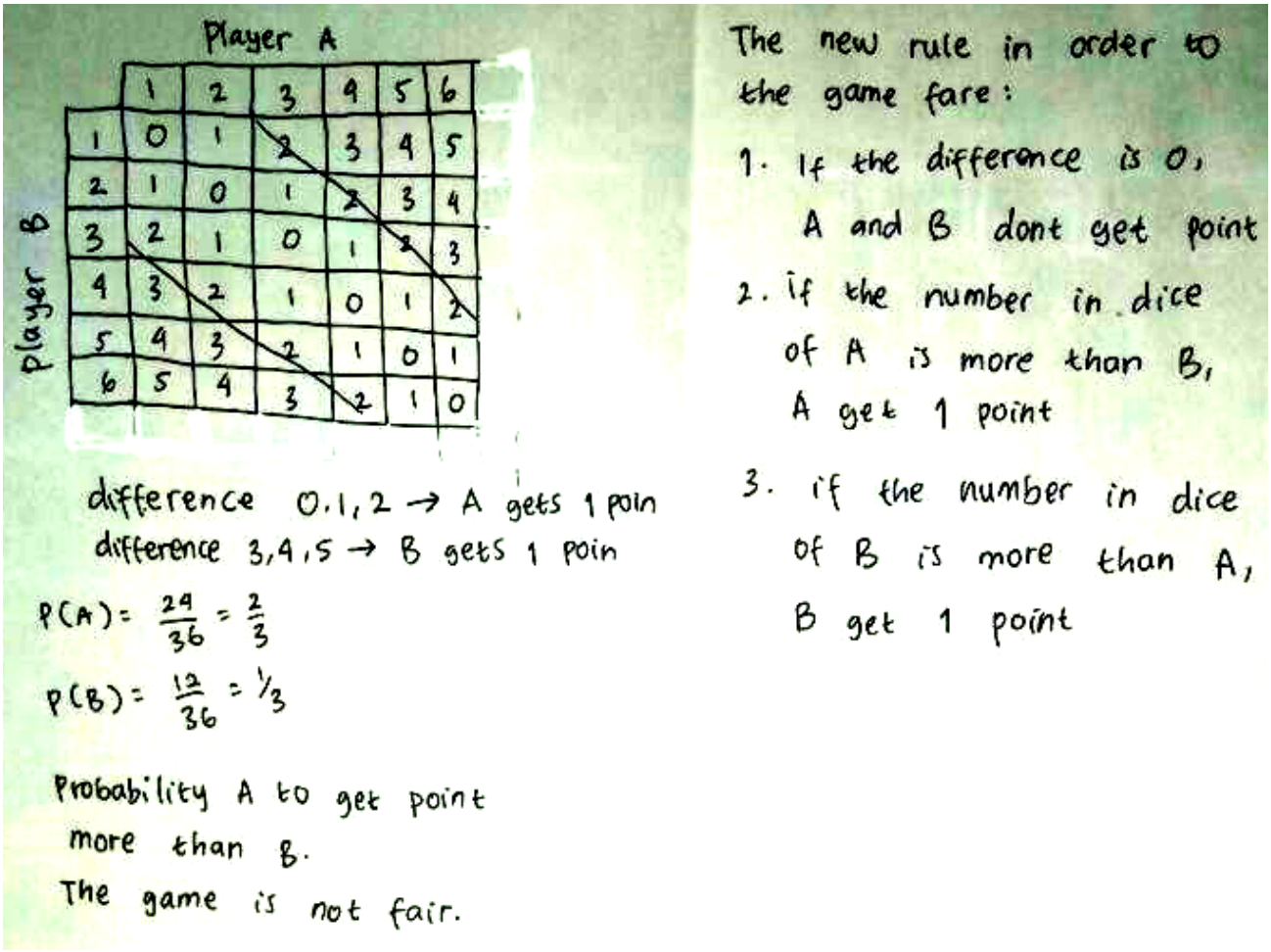

Figure 5. Teacher 25's Answer

Many teachers have partially true answer. They wrote that the game is not fair, but they didn't give the true reason and the new rule in order to the game will be fair. For example, the T22's answer illustrated in Figure 6. In this answer, teacher wrote the analysis to make the new rule, but had not written the rule. From the answers of teachers to the test, the teachers' skill to solve HOTS problems in mathematics are still low.

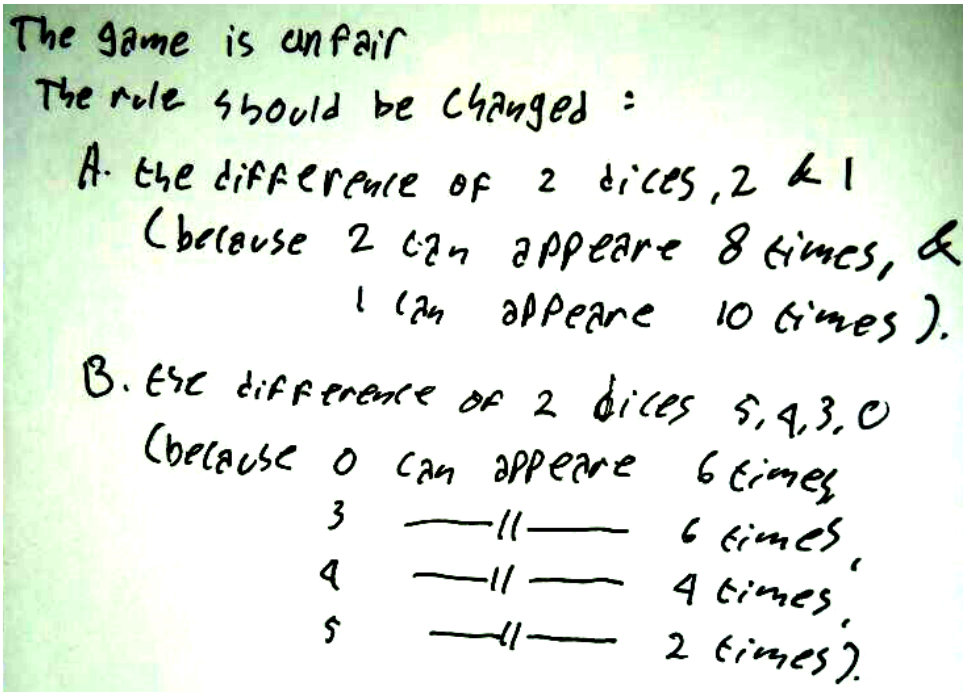

Figure 4. Teacher 22's Answer

Discussion

Curriculum 2013 is the latest curriculum that has been implemented in Indonesia since 2013. One of the contents developed in Curriculum 2013 is higher-order thinking skill (HOTS). According to revised Bloom's taxonomy (Anderson & Krathwohl, 2001), HOTS is an incision between the top three components of the cognitive process dimension (analysis, evaluation, and, creation) with the top three components of the knowledge dimension (conceptual, procedural, and metacognitive). Based on the definition, the possibility of teachers to understand the whole concept of HOTS is still lacking. Moreover, teachers will have greater difficulties to apply HOTS in learning, if not accompanied by socialization and training from the government on a regular basis.

The result of this study indicate that there is still a teachers' misunderstanding regarding HOTS. Some teachers assume that HOTS is the learning phase (Teacher 1 and Teacher 7). The other teacher also assume that HOTS is a method of learning (Teacher 10). Considering the fact that some teacher still understand HOTS partially, socialization and training are still needed in order to introduce HOTS to mathematics teacher. The quality of socialization and training are important, so that teacher can get more understanding and skill on HOTS through these activities. Retnawati (2015) also stated that based on qualitative study, teacher training and Curriculum 2013 socialization are still insufficient. Some issues are found in teacher training and socialization, such as multiple interpretations in term of training and socialization theme and time limitations so that the materials are not delivered completely. These issues need to be considered for the further training and socialization.

HOTS is one of the important things that become the orientation of education implementation. There are two main reason that underlying that statement which are students have to perform successfully in school and students also should make a positive contribution in the society (Conklin, 2012). Therefore, HOTS becomes very important to be applied in learning process, so that students have the preparation to contribute to the society. In learning mathematics, HOTS is one of the determinant factor of student success in learning mathematics. The complexity

of materials and problems in mathematics also requires educators; teachers and students; to have higher-order thinking skils. Not only students, teachers also realize the importance of HOTS for students.

The presence of HOTS issues in the implementation of learning in Indonesia requires a number of changes in the implementation of learning. Ahmad (2014) revealed that there are two teacher perceptions about the educational change, positive perceptions and negative perceptions. Positive perceptions cultivate a desire for change and innovation, whereas a negative perception indicates the teachers' unpreparedness in making changes. Both teacher and student are related to the urgency of HOTS. A study conducted by Avargil, Herscovitz, and Dori (2012) found that students also support teacher professional development, and so do the teachers. It can be seen from one teacher's response that reveals the importance of HOTS "*because we encounter some problems that need knowledge, skill, and analysis in solving daily life problems*". In the response, teachers use the word "*us*" instead of "*student*" or "*them*", which means that HOTS is not only required by the students but also by the teacher himself.

Result show that teachers have realized the importance of HOTS. Teachers' awareness illustrates that teachers are ready to make changes or improvements in the implemtation of learning. Although in some previous research (Jailani & Retnawati, 2016; Retnawati, 2015; Retnawati et al.; 2016; Retnawati, et al., 2017) demonstrated a number of teacher difficulties in implementing a learning model or assessment model that suits the demand of Curriculum, the results of this study indicate that teachers believe the importance of the implementation of HOTS in learning process. This belief will foster the spirit of teachers in doing innovation and change which in line with the positive perceptions of teachers to curriculum changes and also foster teachers desire to innovate in order to support the implementation of the new curriculum (Ahmad, 2014).

Realizing the importance of HOTS, teachers need to teach the skill to students. The designed learning activities should develop students' HOTS. Some research results indicate that it is necessary altering traditional learning methods to innovative learning methods in learning HOTS such as student-centred learning (Sumarmo & Nishitani, 2010), using constructivism, and providing opportunities for students to explore their abilities through problem-solving activities (Apino & Retnawati, 2017; Djidu & Jailani, 2016a). Some models of learning that belong to innovative learning are: problem-based learning (Djidu & Jailani, 2016b), project-based learning (Anazifa, 2017), discovery learning (Rochani, 2016), and creative problem solving (Apino & Retnawati, 2017).

Result also indicate that most teachers already know that teaching HOTS to students can use various models of learning such as problem-based learning, project-based learning, inquiry learning, and problem solving. The utilization of HOTS question using contextual problems or PISA problems is also mentioned by the teacher as one of the strategies to train HOTS. Related to the teachers' knowledge on teaching HOTS using various learning models, they likely have already obtained information from training of the implementation of Curriculum 2013. In addition, they possibly get the information about learning models in teachers' textbooks or other references. However, teachers' knowledge on various learning models cannot be used as standard on measuring teacher success in teaching HOTS. Teachers also need to know activities in a particular model of learning, so that it can increase students' HOTS. It is necessary, so that teachers can give more attention to these activities.

Based on some previous research, the implementation of mathematics learning on the improvement of students' HOTS can be conducted using some activities, such as involving students in non-routine problem-solving activities, providing opportunities for students to construct knowledge and improve the ability to analyze, evaluate, and create (Apino & Retnawati, 2017), involving students to conduct group discussions, and communicating problem-solving results through presentations (Djidu & Jailani, 2016b). In other words, building HOTS-oriented learning

can be conducted through minimalizing teacher domination and maximizing the role of students in learning process in the classroom.

Result reveal that teachers have a good knowledge on teaching HOTS to students. Teachers have mentioned some of instructional models that contain problem-solving activities. Teachers, however, are confuse to explain the activities that can increase students' HOTS. It shows an inconsistency between the knowledge of teaching HOTS and knowledge of activities that can improve HOTS. It also indicates that the pedagogical knowledge of teachers on how to learn and improve HOTS is still limited in term of conceptual knowledge.

HOTS-oriented mathematics learning aims to improve students' HOTS. Measuring students' HOTS in mathematics is important because it is used to know whether the purpose is achieved or not. Students' HOTS can be measured through assignments and tests which constructed based on the aspects and indicators of HOTS. Assignment can be applied by constructing rubrics, while test can be conducted by constructing various type of tests, such as multiple choice questions or essay. Both assignment and test have specifications in measuring students' thinking skill. Multiple choice is more appropriate for measuring analyzing skill and evaluating skill, whereas essay is more appropriate for measuring creating skill. In addition, Watson, Collis, Callingha, and Moritz (1995) recommend an open ended question to measure students' thinking ability that followed by scoring system. A research result conducted on 25 mathematics teacher candidates in Turkey showed that teachers still make mistakes in assessing students' thinking ability in making mathematical model from a given problem (Didis, Erbas, Cetinkaya, Cakiroglu, & Alacaci, 2016). The results also show that there are still many teachers who only assess students' thinking skill based on the final outcome (only providing an assessment: true or false, good or bad, appropriate or inappropriate). Meanwhile, only a few students judge by observing the process of completion.

Compared with the study conducted by Didis et al. (2016), this study shows different results. Based on the analysis of mathematics teacher response data (see Table 5), it can be concluded that teachers have a good understanding in assessing students' thinking ability. It can be seen from teachers' response that measuring HOTS can be carried out by constructing essay using contextual problem. Assessment focuses not only on the students' final answer but also on the process of its completion. This result is relevant to Altun and Akkaya (2014) that most of teachers argue that the cause of students' low ability in answering questions such as PISA, it is because students are unfamiliar with PISA questions. Teachers as respondent also provided recommendations that evaluation of students' learning outcome might be carried out by using essay and contextual question. These suggestions show that teachers already know the question types which can be properly used in measuring HOTS. Some study in some countries (e.g. Altun & Akkaya, 2014; Didis et al., 2016; Stahnke, Schueler & Roesken-Winter, 2016) revealed that one of the determinants factor of student success in improving competence and thinking ability is the teacher competence and teachers' mastery to the learning content. In addition, not only mathematical pedagogical content knowledge (MPCK), teachers must also increase their mathematical content knowledge (MCK) (Blömeke & Delaney, 2012).

The result of this study indicate that mathematics teachers have not performed well in answering HOTS problem. Most teachers do not include a clear step in answering the question. This is an indication that teachers' mathematical content knowledge (MCK) is still low, especially relating to the ability in solving the HOTS question. These results are in line with Zulkpli, Mohamed, and Abdullah (2017) who revealed the low level of thinking ability in primary and secondary school teachers in a province in Malaysia. This condition will certainly affect students' learning achievement that is not maximal (Altun & Akkaya, 2014; Didis et al., 2016; Stahnke et al., 2016). In addition, these results also indicate inconsistencies between teachers' responses in measuring HOTS and answering HOTS problem. Although teachers have revealed that assesing HOTS should not ignore the process or completion of problem solving steps, but when solving

HOTS problem, most of them only write the final results and do not include the process of completion.

Conclusions

The results of this research indicate that not all teachers understand HOTS well. Teachers still unable to distinguish between HOTS as the ability, skills learning methods, learning models or learning activities. Teachers already have awareness on the importance of HOTS in students. However, teachers' knowledge on the importance of HOTS has not been accompanied by good knowledge on learning and improving HOTS. Although teachers already know that HOTS can be trained to students by using some learning models (e.g. problem-based learning, project-based learning, inquiry learning, cooperative learning), teachers still confuse explaining activities in particular model of learning. The implementation of Bloom's Taxonomy has also not been seen in teacher responses in terms of measuring and assessing HOTS. In addition, the low level of teachers' knowledge on HOTS is also caused by the low ability in solving HOTS problems. The results of this study confirm that the low level of pedagogical abilities relating to HOTS is in line with the low ability of teachers' HOTS.

Although teachers are the main aspect in the implementation of learning process, all educational components have equal responsibility in improving education in a country. Results also reveal that teachers' pedagogical knowledge and HOTS are the main concern in educational improvement. Government and education experts should find solutions in solving this problem. Therefore, conducting socialization and teacher training on improving HOTS and its implementation in mathematics learning is one of recommendations that might be applied. In addition, learning sources such as books, access through electronic media, or other sources still need to be considered by the government, as well as schools and education experts.

Many researches can be conduct related to the findings of this research. The teachers' knowledge and skill need to be described more broadly and deeply, so that it can be known in which part that ability is less and needed effort to improve it. The strategy to improve the quality of teachers, especially mathematics teachers related to professional and pedagogical competence. Similarly, the supporting media need to develop so that can be used by teachers in improving their qualifications in managing and implementing innovative teaching and learning in their school.

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TEACHERS' KNOWLEDGE ABOUT HIGHER-ORDER THINKING SKILLS AND ITS LEARNING STRATEGY

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Abstract

Higher order thinking skill (HOTS) is one of the students' abilities that should be developed through teaching and learning. Teachers' knowledge about HOTS and its teaching and learning tactics is a key to successful education. The purpose of this research is to describe teachers' knowledge about higher order thinking skills (HOTS). The research involves qualitative study with the phenomenological approach. The research participants are 27 mathematics teachers from state and private junior high schools across 7 provinces in Indonesia. The researcher collected data with a test followed by focus group discussion (FGD) and interviews. The analysis of data involved Bogdan & Biklen model and descriptive statistics for data from the test. The analysis of FGD, and test data intends to get information on 6 sub-themes; teachers' knowledge about HOTS, importance of HOTS, teaching about HOTS to students, improving students' HOTS, measuring and assessing HOTS, and teachers' ability for solving HOTS-based problems. The results indicate that teachers' knowledge about HOTS, their ability to improve students' HOTS, solve HOTS-based problems, and measure students' HOTS is still low. There are facts, however, that teachers already understand the importance of HOTS and teaching it by using various innovative learning models.

Keywords*: HOTS, measurement and assessment, teachers' knowledge, teaching and learning*

Introduction

Education is one of the important aspects that can affect national vision. Success in educational implementation is a key to a better future. The latter cannot be achieved without the contribution of various stakeholders. The government, as a policymaker, has the main role and responsibility to pave the way to success, by pledging education for all throughout the nation, for example, education for free policy in developing countries (Quamruzzaman, Rodríguez, Heymann, Kaufman, & Nandi, 2014). Aside from the government's role, teachers also play an overwhelming role because they put in practice all educational policies and regulations.

Education quality is not only determined by the plan and the development of education but also the quality of its implementation. It also requires supervision of different partners, such as education experts, practitioners, and stakeholders. All of them must synergize to achieve

educational success, this means that it not only focuses on the improvement of evaluation, updated curriculum, and new regulations, but also on the development of teaching professionalism (Purnomo, 2017). Some studies revealed that teachers already a great contribution to improving education quality in many countries (Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017; Hu, Fan, Yang, & Neitzel, 2017; Stylianides, 2007). Therefore, the quality of a teacher to implement educational policy affects the quality of education.

The efforts to improve the quality of education cannot be separated from the demands of 21st century competitiveness which is complex and challenging. There are three main frameworks of 21st-century skills: 1) learning and innovation skills, 2) life and career skills, and 3) information, media, and technology skills (Scott, 2017). Learning and innovation skills consist of communication, collaboration, critical thinking, and creativity skills (4CS). Life and career skills consist of flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, leadership, and responsibility. Furthermore, information, media, and technology skills consist of information and media literacy. In addition, Bialik (2015) mentioned four key issues in the 21st-century education implementation framework: Knowledge, skill, character, and metacognition.

Related to the skill, Bialik (2015) and Scott (2017) mentioned that it is relevant to the 4CS competence, which includes creativity, critical thinking, communication, and collaboration. Scott (2017) and Bialik (2015) stated that the 21st-century skills can be grouped into two main components: abstract skills related to thinking skills (creative thinking and critical thinking), and concrete skills (communication and collaboration). Moreover, creative thinking skills and critical thinking skills are included in higher-order thinking skill (HOTS) (Miri, David, & Uri, 2007; Moseley, Baumfield, Elliott, Gregson, Higgins, & Newton, 2005).

HOTS is one of the important components for an individual to be able to solve new problems in the 21st century (Brookhart, 2010; Moseley et al., 2005; Thompson, 2008). HOTS also plays an important role in applying, connecting, or manipulating the prior knowledge in order to effectively solve new problems (Thomas & Thorne, 2009). In the revised Bloom's taxonomy, HOTS is defined as an incision among the three top levels of ability in the cognitive dimension (analyzing, evaluating, creating), and 3 levels of knowledge dimension (conceptual, procedural, metacognitive) (Anderson & Krathwohl, 2001, Thompson, 2008). Therefore, HOTS is measured using tasks, including analyzing, evaluating, and creating conceptual and procedural knowledge, or metacognition. This means that familiarizing students with HOTS activity is important to help them get ready for solving new issues, acclimatizing themselves in a new atmosphere, and making decisions about a particular problem.

In the implementation of learning, HOTS cannot be directly taught to students. Students should be trained about HOTS, as a skill, through learning activities that support its development. Active learning and student-centered learning are activities for training about HOTS (Akyol & Garrison, 2011; Limbach & Waugh, 2010). The active learning and student-centered learning such as problem-based learning (PBL) (Mokhtar, Tarmizi, Job, & Nawawi, 2013), project-based learning (PjBL) (Vidergor & Krupnik-Gottlieb, 2015), discovery learning, and inquiry-based

learning (Orlich, Harder, Callahan, Trevisan, & Brown, 2010), or other learning models using contextual problems are some examples of strategies for training students about HOTS. In addition, Protheroe (Goethals, 2013) and Miri, David, and Uri (2007) mentioned that group discussion and solving complex and interdisciplinary problems in the learning process are important activities to train students' HOTS.

The outcome from students' HOTS development can be achieved by the active role of teachers in planning, implementing, and evaluating HOTS-oriented learning. To be able to plan HOTS-oriented learning, teachers need knowledge of ways, strategies, methods to train students about HOTS (Bartell, 2012). Some research results, however, indicate that mathematics teachers face some difficulties, particularly when training their students about HOTS. The obstacles they encounter including difficulty to develop HOTS-based problems and find suited learning tools (Jailani & Retnawati, 2016; Retnawati, Munadi, Arlinwibowo, Wulandari, & Sulistyaningsih, 2017; Thompson, 2008), there are also difficulties to evaluate students' HOTS (Retnawati, Hadi, & Nugraha, 2016). Various obstacles also implicate the low-level of students' HOTS, they mark difficulties when solving mathematics problems in the national exam with contextual problem and narration (Retnawati, Kartowagiran, Arlinwibowo, & Sulistyaningsih, 2017).

Research Problem

Based on the description, it is still needed to conduct the assessment of teachers' knowledge about HOTS and its learning strategies. Throughout this research, it is expected to get a broad picture of teachers' knowledge about HOTS and its learning strategy. This information assists in planning programs that can increase teachers' knowledge about HOTS and its learning strategy. Therefore, this study intends to describe teachers' knowledge about HOTS and its teaching strategy in mathematics classroom.

Researcher's Role

In this research, the only relationship between the researcher and participants is to collect and explore data with test, focus group discussion (FGD), and interviews resulted from teacher knowledge about HOTS. The next step was to analyze the data for having advanced understanding. The researcher did not undertake any treatment upon the participants in terms of the teacher's knowledge and mathematics teaching and learning strategies implemented by the teachers in the classroom.

Research Methodology

Research Type

This research is a qualitative study in the phenomenological approach. This research aims to explore teachers' knowledge of HOTS and their teaching strategy in mathematics classroom.

Research Participants

The research participants were 27 mathematics teachers (14 female against 11 male; T1-T27) from 13 private Junior High Schools and 14 state Junior High Schools from 7 provinces in Indonesia. They were randomly selected. All teachers have more than 10 years of experience teaching Mathematics in Junior High School. They haven't participated in training for HOTS and its teaching and learning strategy yet.

Instrument and Procedure

The teachers passed a test, involved in Focus Group Discussion (FGD) and in-depth interviews so that the researcher could get detailed information. The test consists of 2 constructed response items that adapted from PISA released items. Two mathematics education experts had validated the items. FGD and interviews topics consist of six sub-themes: 1) Teachers' knowledge on HOTS, 2) importance of HOTS, 3) learning strategy in implementing HOTS, 4) improving students' HOTS, 5) measuring and assessing HOTS, and 6) teachers' ability to solve HOTS problems. The test was also administered to measure teachers' HOTS by giving them HOTS problems in Figure 1.

Data Analysis

Data from FGD and interviews were analyzed and presented in a table to be classified into sub-themes. Analysis of data from the FGD involved Bogdan and Biklen model (1982) in order to know the relationship among sub-themes. On the other hand, the analysis of teachers' answers about solving HOTS problems involved descriptive analysis.

Ethical Consideration

At the beginning of the FGD and interviews, the researcher informed the participants that the study would only capture their knowledge about HOTS and its teaching and learning strategy. The FGD and interviews were naturally conducted to obtain credible information. The teachers' names were kept and for the purpose of the research, their identities were coded to ensure their answers have no effect on their professions as teachers.

1. Magazine Subscription

Geo-Picture magazine monthly subscription:

Geo-Picture Magazine Category	Price List
Geo-Picture Indonesia	Rp50.000,00
Geo-Picture Traveler	Rp45.000,00
Geo-Picture for Kids	Rp20.000,00

The magazine also offers annual subscription packages. If you subscribe at least two magazines in a year, you will get the discounts which are listed below:

Geo-Picture Magazine Category			Price List
Geo-Picture Indonesia	Geo-Picture Traveler	Geo-Picture for Kids	
✓	✓		Rp600.000,00
✓	✓	✓	Rp600.000,00
		✓	Rp444.000,00
✓	✓	✓	Rp804.000,00

If Rudi wants to subscribe the magazines, which one is the cheapest package that should be choosen by Rudi? Explain!

2. Dice game

Two players threw a dice. From the dice number that appears, the larger dice number is reduced by the smaller dice number. If the difference is 0, 1, or 2 then player A gets 1 point. However, if the difference is 3, 4, or 5 then player B gets 1 point. The game ends after 12 dice and the player with the most points is the winner. Is the game fair? If the game were unfair, how would the rules be changed to make the game fair?

Figure 1. The test to measure teachers' ability in solving HOTS problems

Research Findings

Result gives information about teacher's perceptions towards mathematics learning to improve HOTS. The teachers' perceptions are classified into teachers' knowledge on HOTS, its importance, its implementation learning strategy, its improvement in students, its measurement and assessment, and teachers' ability to solve HOTS-based problems. The researcher explained every sub-theme here below.

Teachers' Knowledge about HOTS

The results out of data analysis and reduction of teachers' knowledge about HOTS show that their knowledge about HOTS is still low. Some explanations given by teachers are general. In fact, there are many teachers who are still confused about distinguishing between HOTS and its strategies or learning methods. The same results can be seen in Table 1. The findings indicate that some teachers have explained HOTS using the three top levels of the revised Bloom's taxonomy (analyzing, evaluating, and creating) while others use critical thinking skill, creativity, problem-solving, logic, reflective, and metacognitive. Based on the FGD result, new teachers are able to understand conceptual knowledge, but cannot explain the operational knowledge properly. Based on teachers' responses, not all teachers understand HOTS well. Teachers still cannot differentiate among abilities, skills, learning methods or learning activities. Although the term HOTS always appears in teacher training activities and socialization of Curriculum 2013, teachers cannot understand its definition.

Table 1. Teachers' Knowledge about HOTS Definition

Definition of HOTS according to Mathematics Teachers	Verification Result
1. Learning stage that requires mastery of the correct concept 2. Thinking skill that is more than just memorizing and reading 3. High cognitive process, such as analysing, evaluating, and creating 4. Thinking ability through understanding, observing, exploring, and inferring data 5. Critical thinking skill, creativity, logic, problem-solving, and metacognitive 6. Learning process which includes knowledge, skill, and analysis 7. High-level problem-solving ability 8. Problem analysis skills 9. Learning methods which are not just for solving a problem but understanding it at a high level 10. Ability to solve problems with various ways	Not all teachers understand HOTS well. Teachers are still unable to distinguish HOTS as an ability, skill, learning strategy, learning method, or learning process.

Teachers' Knowledge about the Importance of HOTS

Table 2 contains the findings out of data analysis and reduction for teachers' knowledge about HOTS. Teachers' responses to the second sub-theme prove that most of the teachers said that HOTS is important because of its advantages in solving various and complex problems. Therefore, HOTS-oriented learning is very important in learning process as far as it helps solve daily life problems.

Table 2. Teachers' Knowledge about the Importance of HOTS

The Importance of HOTS	Verification Result
1. In learning mathematics, students' task is not mastering the concept but also engaging problem-solving skills 2. Training both students' thinking and problem-solving skills 3. Making a coherent learning process, such as analysing problem and evaluating 4. Being able to think and carefully solve very difficult problems 5. Training students in critical thinking 6. Not separating HOTS from the cognitive elements of critical thinking skills, creativity, problem-solving, logic, reflective, and metacognitive 7. Needing knowledge, skill, and analysis skill in solving problem that might be faced in daily life 8. HOTS is required to solve problem 9. Reaching out routine and unexpected problems (non- routine problem) 10. Studying easily by using HOTS	Most teachers have realized the importance of HOTS for students, i.e. improving students' skills in solving daily life problems.

There are other responses show the importance of HOTS, it makes students easier to learn. Based on their responses, some teachers still argue about the importance of HOTS. They stated that HOTS is used to train children to think critically (T5). By teachers' responses, it is worthy to conclude that teachers already know the importance of HOTS. The majority of respondents are aware of the importance of HOTS.

Teachers' Knowledge about Implementing HOTS in Learning Process

For the third sub-theme, teachers were asked to explain the strategies for teaching HOTS. In the same sub-theme, teachers are expected to describe learning model that can be suited to teaching HOTS in mathematics topics. The results can be seen in Table 3.

Table 3. Teachers' Knowledge about Implementing HOTS in Learning Process

Ways of Implementing HOTS in Learning	Verification Result
1. Learning atmosphere should be fun, mastering of basic concepts must be strong, using small groups, using HOTS questions as a habit, developing perseverance and curious attitude 2. Using problem-solving approach and giving analysis-related questions 3. Teaching students to analyze, evaluate, and create systematically 4. Training students to use complex questions and articulate problems, and asking them to find an answer by following a particular procedure 5. Providing problems related to their daily problems 6. Applying problem-solving approach 7. Giving students problems or HOTS-based questions 8. Understanding, identifying, determining formulas, and solving problems 9. Giving PISA questions to students 10. Applying problem- based learning, project-based learning, active learning, inquiry learning, and cooperative learning	Teachers know that teaching HOTS can be done by using various learning models. Teachers are able to mention a number of learning models for teaching HOTS.

Results show that teachers' knowledge on teaching HOTS has a positive impact. The teachers believe that training students' HOTS can be done through various learning models. The results also indicate that teachers already know that teaching HOTS to students can be carried out by learning activities containing problem-solving. In addition, teachers' responses proved their knowledge about problem-based learning, project-based learning, active learning, inquiry learning, and cooperative learning.

Teachers' Knowledge about Improving Students' HOTS

The results about teachers' knowledge on improving students' HOTS can be seen in Table 4. In this sub-theme, teachers were asked to explain learning activities which can improve

students' HOTS, the results indicate that they are still unable to explain how to improve students' HOTS, either conceptually or operationally.

Teachers' answers show their misunderstanding about the operational implementation of learning activities to train about HOTS. Most of the answers given by teachers are still normative, such as "asking students to think critically", "Continuously training them about thinking skills", and "training them by asking questions, creating group discussions, giving analysis (C4) or evaluation (C5) related questions".

Table 4. Teachers' Knowledge about Improving Students' HOTS

Mechanisms to Improve Students' HOTS	Verification Result
1. Learning habit and mentorship 2. Engaging practice by asking questions, creating discussion groups, giving C4 or C5 questions 3. Making games followed by increasing the level of thinking 4. Training by providing questions that contain high-level thinking process 5. Applying problem-based learning model 6. Designing methods, techniques, or approaches which can improve HOTS 7. Giving students problems ordered from low to high level 8. Providing students with problems from easy to difficult level 9. Assigning students to read more HOTS literature 10. Reading a lot of reference books and exchanging knowledge, methods, or knowledge with friends 11. Asking students to think critically	Most teachers still cannot explain how to improve students' HOTS, either conceptually or operationally.

Teachers' Knowledge about Measuring and Assessing HOTS

The results from data analysis and reduction are summarized in Table 5.Their responses indicate that most teachers can measure and assess HOTS, by describing, confirming based on observation and presentation, and scoring.

Table 5. Teachers' Knowledge about Measuring and Assessing HOTS

How to Measure and Assess HOTS	Verification Result
1. Conducting interview with some students on the difficulty of HOTS problems 2. Measuring students' understanding on solving problems, constructing and finding solutions, and evaluating the outcomes 3. Observing the effort of students in thinking and solving their problems, by themselves 4. Analysing students' answers especially in the process of completing the answers 5. Using written assessment and observation	Most teachers already have idea about appropriate instruments to assess HOTS, such as essays, observation of problem-solving process, confirmation relying on observation and presentation, and scoring system.

6. Conducting assessment of the process and final evaluation. Developing an instrument measuring high-level skills
7. Using essays, assessing the process of finding solutions and stating final solution, interviewing students or assessing their presentations
8. Giving continuous problems and observing the improvement
9. Giving essays rooted on students' daily life problems
10. Using assessment sheet, essay test, and open-ended problems

The results make it clear that teachers already know about different instruments suited to measuring HOTS, such as essays with contextual problems. Other responses explain the techniques for assessing procedures for not appraising the outcome only. These results indicate that teachers already know the instruments used to conceptually measure HOTS. These responses, however, only explain the assessment process regarding problem solving steps, none of them clarifies how to measure or assess HOTS with Bloom's taxonomy.

Teachers' Ability for Answering to the HOTS-Based Questions

In this study, the researcher asked teacher to find answers to some problems in order to find out teachers' HOTS. Examples of teachers' answers in solving the first HOTS problem are listed below.

> "The cheapest package is the fourth one because if the normal price per annual subscription is calculated, the first package price drops by Rp540.000,00, the second by Rp240.000,00, and the third Rp336.000,00, and the fourth Rp576.000,00" (T1)
>
> "The packages that should be chosen are Geo-Picture Indonesia and Geo-Picture Traveler which is only for Rp600.000,00 because the subscription price of each magazine is cheaper than Geo-Picture for Kids" (T2)
>
> "I can choose Geo-Picture Indonesia, Geo-Picture Traveler, and Geo-Picture for Kids for Rp804.000,00 because they have the biggest discount" (T3)
>
> "I can choose 3 books from the first package because if the price is accumulated, it has more discount" (T4)
>
> "I can choose Geo-Picture Indonesia and Geo-Picture Traveler package because the discount is bigger than other packages" (Teacher 5)

From the five answers, the right answer is the answer from Teacher 1, He systematically solved the problem of "Magazine Subscription" and identified important information by analyzing, investigating, solving problems (creating), evaluating and drawing conclusions. The way he solved the problem is presented in Figure 2.

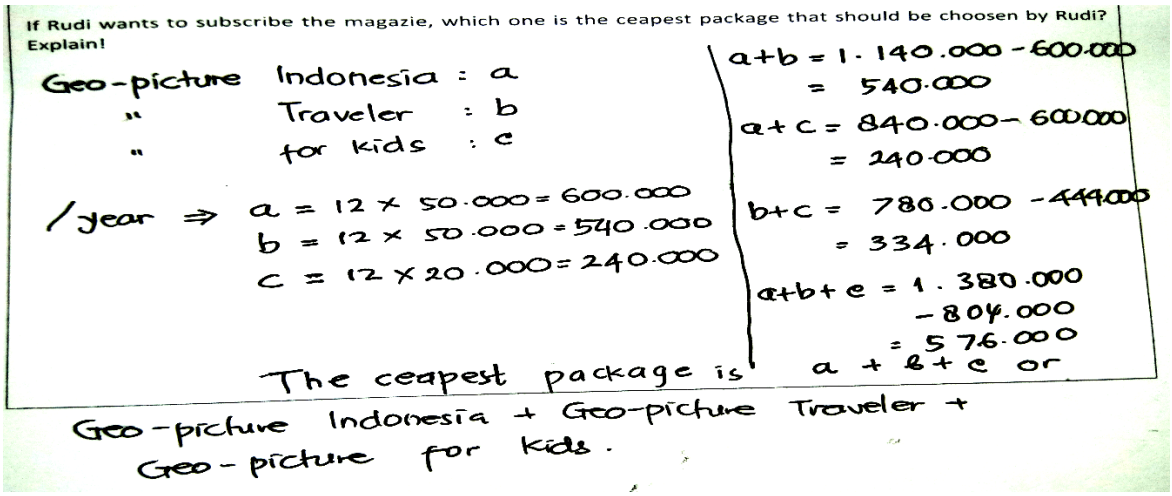

Figure 2. Answer by Teacher 1

Figure 2 is an example of the correct answer. Teacher 1 solved the problem by separating the magazines, determined the price of each magazine within one year, and then the discount for each package. After that, he took the decision by considering the biggest discount. Therefore, according to Teacher 1, the cheapest package that should be chosen by Rudi is the fourth one. Teacher 3 and Teacher 4 actually have the correct answer, but their answers are not built on problem-solving process. Figure 3 contains the work by teacher 3.

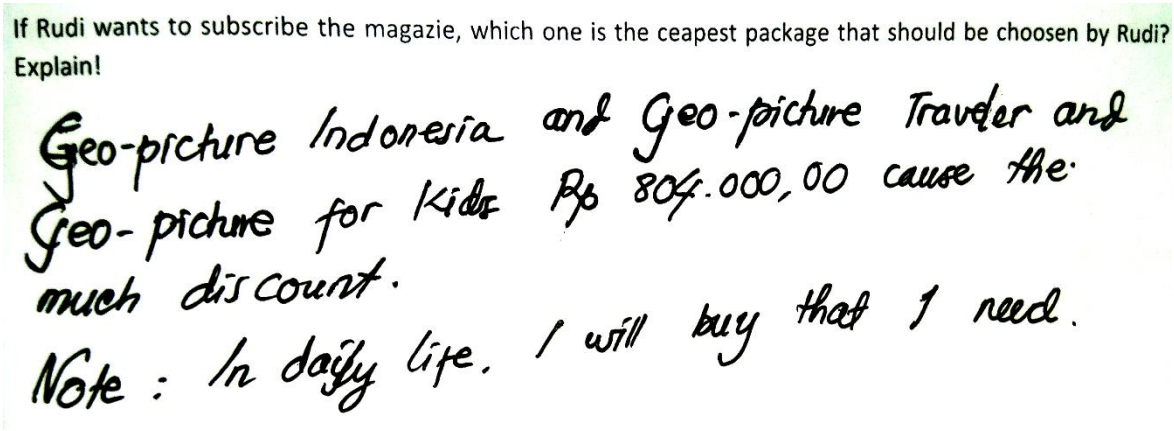

Figure 3. Answer by Teacher 3

Figure 3 is an example of the correct answer but not complete with clear and detailed completion process. It can be seen in Figure 3 that Teacher 3 chose the fourth package because of its discount. The discount referred to by Teacher 2, however, is not included in the process of drawing his conclusion. The way of understanding of teacher 2 is still partial in solving HOTS-based problems. In contrast, Teacher 2 and 5 gave different answers from three other teachers. Teacher 2 selected the second package because he compared prices of all magazines, whereas Teacher 5 preferred the first package because of its price. Figure 4 illustrates the work of Teacher 2 on the problem.

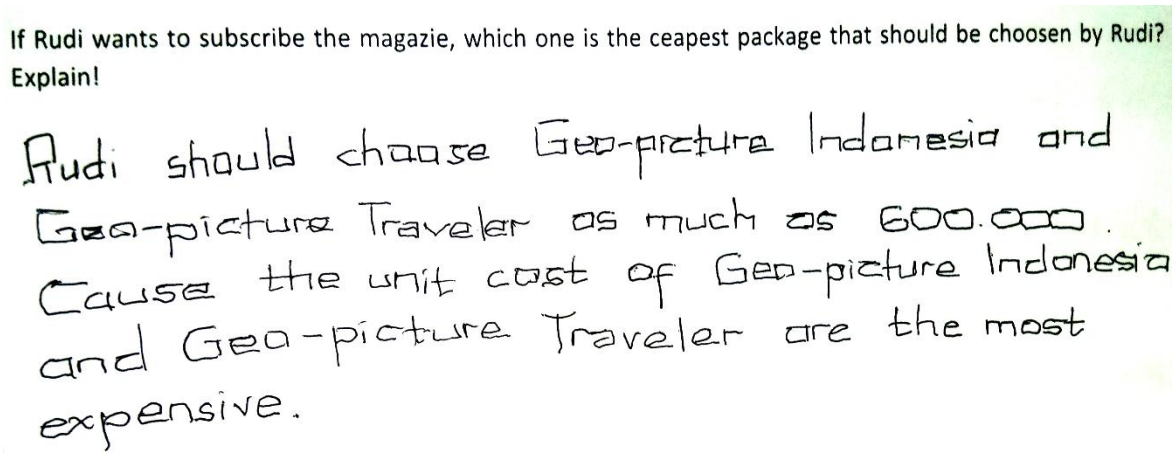

Figure 4. Answer by Teacher 2

Figure 4 is an example of the wrong answer. The mistake of teacher 2 lies within his process of drawing conclusion, the process is not accompanied with a clear completion. Teacher 2 selected the first package (Geo-Picture Indonesia and Geo-Picture Traveler) because the price of each magazine in the package is the most expensive comparing to each price of the Geo-Picture Traveler. The reason was given by Teacher 2, however, is not appropriate to answer the question. There are two possibilities that cause teachers to make wrong answers. First, the teacher does not understand the question. Second, the teacher does not understand the discount concept. Therefore, it can be concluded that Teacher 2 skills to solve the HOTS problem is still low.

For the second HOTS-based problem, the teachers' answers vary. The sample of them is listed below.

"In my opinion, the game is fair" (T7, T9, without reason)

"A is as probable as B, ½" (T15, without mentioning fair or not fair)

"The game is not fair because the probability of A is different from that of B." (T20, T24)

The answers of T7, T9, and T15 are wrong, and the answers of T20 and T24 are partially correct. The correct answer is from T25, Figure 5.

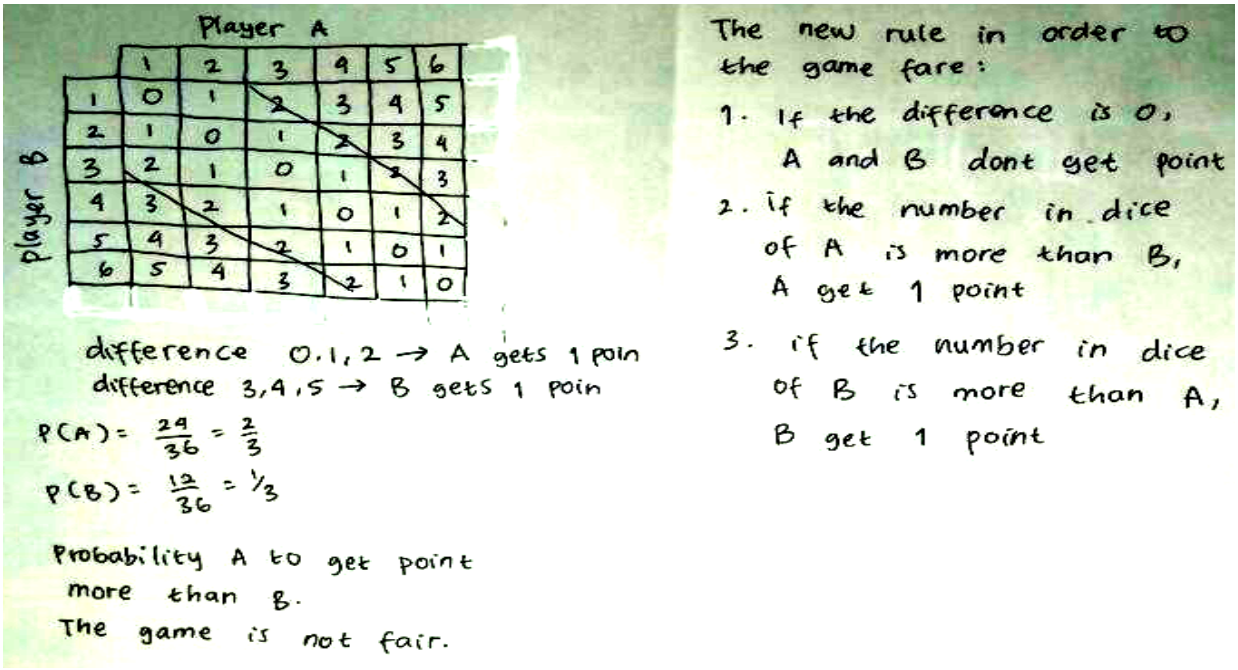

Figure 5. Answer by Teacher 25

Many teachers have partially made correct answers. They wrote that the game is not fair, but they didn't give the reason behind or propose the new rule to turn the game fair. For example, the T22 answer illustrated in Figure 6. In this answer, the teacher wrote the analysis to make the new rule but did not write the rule. From the answers of teachers to the test, the teachers' skills to solve HOTS problems in mathematics are still low.

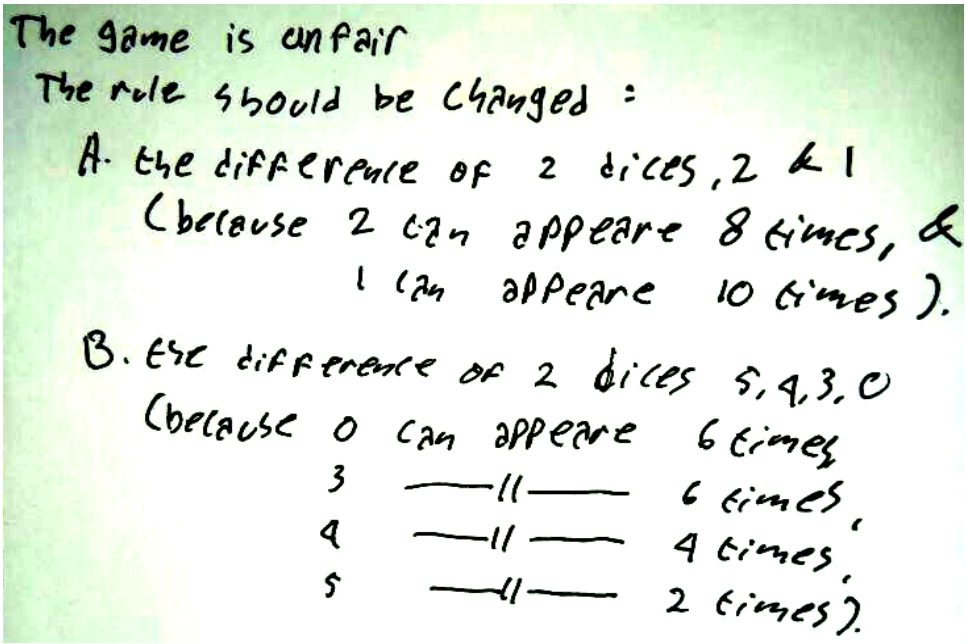

Figure 4. Answer by Teacher 22

Discussion

Curriculum 2013 is the latest curriculum that has been implemented in Indonesia since 2013. One of the components of the Curriculum is higher-order thinking skill (HOTS). According to the revised Bloom's taxonomy (Anderson & Krathwohl, 2001), HOTS is an incision between the three top components of cognitive process dimension (analysis, evaluation, and, creation) with the three top components of knowledge dimension (conceptual, procedural, and metacognitive). Based on the definition, the possibility of teachers to understand the whole concept of HOTS is still lacking. Moreover, teachers will have hugely difficult moments to apply HOTS in learning process, if not accompanied by socialization and training from the government on a regular basis.

The findings of this study indicate that teachers still misunderstand HOTS. Some teachers assume that HOTS is the learning phase (Teacher 1 and Teacher 7). Another teacher also assumes that HOTS is a method of learning (Teacher 10). Considering the fact that some teachers still partially understand HOTS, socialization and training are still needed in order to introduce HOTS to mathematics teachers. The quality of socialization and training is important so that teachers can get more understanding ability and skills about HOTS through these activities. Retnawati (2015) also stated that based on the qualitative study, teachers' trainings and Curriculum 2013 socialization are still insufficient. Some issues are found in teacher training and socialization, such as multiple interpretations in terms of training and socialization themes and time limitations that lead to incomplete delivery of the materials. These issues need to be considered for further training and socialization.

HOTS is one of the important things that become the orientation key of educational policy implementation. There are two main reasons that students have to perform successfully in schools and they should make a positive contribution to the society (Conklin, 2012). Therefore, HOTS is very important to be applied in learning process so that students get ready to contribute to the society. In learning mathematics, HOTS is one of the determinant factors of student success. The complexity of materials and problems in mathematics also requires educators; teachers and students; to have higher-order thinking skills. Both students and teachers should realize the importance of HOTS for students.

The outbreak of HOTS issues in the implementation of learning in Indonesia requires empirical changes. Ahmad (2014) revealed that there are two teacher perceptions about the educational change, positive perceptions and negative perceptions. Positive perceptions cultivate a desire for change and innovation, whereas negative perceptions indicate teachers' unpreparedness to make changes. Both teachers and student are related to the urgency of HOTS. A study conducted by Avargil, Herscovitz, and Dori (2012) found that students also support teacher professional development, and so do the teachers. It can be seen from one teacher's response that HOTS is important "because we encounter some problems that need knowledge, skills, and analysis so that we can fix our daily life problems". In the response, teachers use the

word “us” instead of “students” or “them”, which means that HOTS is not only needed by students but also their teachers.

The results show that teachers have realized the importance of HOTS. Teachers’ awareness demonstrates that they are ready to make changes or improvements during learning process. Although some previous research (Jailani & Retnawati, 2016; Retnawati, 2015; Retnawati et al.; 2016; Retnawati, et al., 2017) demonstrated a number of teacher difficulties in implementing learning or assessment model that fits the demands of the Curriculum, the results of this study indicate that teachers believe the importance of implementing HOTS in the learning process. This belief will foster the spirit of teachers in making innovation and change which in line with the positive perceptions of teachers towards the curriculum changes and also foster teachers desire to innovate in order to support the implementation of the new curriculum (Ahmad, 2014).

To realize the importance of HOTS, teachers need to teach the skills to students. Designed learning activities should develop students’ HOTS. Some research results indicated that it is necessary to alter traditional learning methods to innovative learning methods for learning HOTS. Those innovative methods are student-centered learning (Sumarmo & Nishitani, 2010), use of constructivism, and provision of opportunities to students for exploring their abilities during problem-solving activities (Apino & Retnawati, 2017; Djidu & Jailani, 2016a). Some models of learning that belong to innovative learning are problem-based learning (Djidu & Jailani, 2016b), project-based learning (Anazifa, 2017), discovery learning (Rochani, 2016), and creative problem solving (Apino & Retnawati, 2017).

Results also indicate that most teachers already know that teaching HOTS to students can use various models of learning such as problem-based learning, project-based learning, inquiry learning, and problem-solving. Utilization of HOTS questions with contextual problems or PISA problems was also mentioned by the teachers as one of the appropriate strategies to train for HOTS. Related to the teachers’ knowledge on teaching HOTS by using various learning models, they likely have already been trained about implementing Curriculum 2013. In addition, they possibly get information about learning models from teachers’ textbooks or other references. However, teachers’ knowledge on various learning models cannot be used as a standard for measuring teacher success in teaching HOTS. Teachers also need to know about the activities in each particular model of learning so that it can improve their HOTS. It is necessary for teachers to pay attention to these activities.

Based on some previous research, the implementation of mathematics learning on the improvement of students’ HOTS can be carried out with some activities, such as involving students in non-routine problem-solving activities, providing opportunities to students for constructing their knowledge and improve their ability to analyze, evaluate, and create (Apino & Retnawati, 2017), involving students to undergo group discussions, and communicating problem-solving results through presentations (Djidu & Jailani, 2016b). In other words, building HOTS-oriented learning can be conducted through minimalizing teacher domination and maximizing the role of students in the learning process.

Result revealed that teachers have good knowledge on teaching HOTS to students. The teachers have mentioned some of the instructional models that contain problem-solving activities. The teachers, however, are confused about explaining the activities that can improve students' HOTS. This shows an inconsistency between the knowledge of teaching HOTS and knowledge of activities that can improve HOTS. This also indicates that the pedagogical knowledge of the teachers on how to learn and improve HOTS is still limited in term of conceptual knowledge.

HOTS-oriented mathematics learning aims at improving students' HOTS. Measuring students' HOTS in mathematics is important because it helps know whether the purpose is achieved or not. Students' HOTS can be measured through assignments and tests that are constructed based on the aspects and indicators of HOTS. Assignments can be applied by constructing rubrics, but testing can be used with various types of tests, such as multiple choice questions or essay. Both assignment and test have specifications for measuring students' thinking skills. Multiple choice is more appropriate for measuring analyzing and evaluating skills, whereas essay is more appropriate for measuring creating skills. In addition, Watson, Collis, Callingha, and Moritz (1995) recommended open-ended questions to measure students' thinking ability followed by scoring system. The research conducted on 25 mathematics teacher candidates in Turkey came up with the findings that teachers still make mistakes in assessing students' thinking ability in making mathematical model of a given problem (Didis, Erbas, Cetinkaya, Cakiroglu, & Alacaci, 2016). They also showed that there are still many teachers who only assess students' thinking skill based on the final outcome (only providing an assessment: true or false, good or bad, appropriate or inappropriate). Meanwhile, only a few students judge by observing the process of completion.

Compared to the study by Didis et al. (2016), different results were found. Based on the analysis of mathematics teacher response data (see Table 5), it can be concluded that teachers have a good understanding about assessing students' thinking ability. It can be seen from teachers' responses that measuring HOTS can be carried out by constructing essay with contextual problems. Assessment focuses not only on the students' final answer but also on the process of its completion. This result is relevant to that of Altun and Akkaya (2014) that most of teachers argue that the cause of students' low ability in answering questions such as PISA, the students are unfamiliar with them. Teachers as respondents also provided recommendations that evaluation of students' learning outcome should be carried out by using essays and contextual questions. These suggestions show that teachers already know the appropriate types of questions to measure HOTS. Some study in some countries (e.g. Altun & Akkaya, 2014; Didis et al., 2016; Stahnke, Schueler & Roesken-Winter, 2016) revealed that one of the determinant factors of student success in improving competence and thinking ability is the teacher competence and teachers' mastery to the learning content. In addition to that, not only mathematics pedagogical content knowledge (MPCK), but also increased mathematical content knowledge of teachers (MCK) (Blömeke & Delaney, 2012).

The results of this study indicate that mathematics teachers have not performed well in answering HOTS problem. Most teachers do not include clear procedures in answering the

questions. This is an indication that teachers' mathematical content knowledge (MCK) is still low, especially relating to their ability in solving HOTS-based questions. These results are in line with Zulkpli, Mohamed, and Abdullah (2017) who pointed out the low level of thinking ability among primary and secondary school teachers across one province in Malaysia. This condition will certainly affect students' learning achievement that is not maximal (Altun & Akkaya, 2014; Didis et al., 2016; Stahnke et al., 2016). Besides, these results also indicate inconsistency within teachers' responses in measuring HOTS and answering to HOTS-based problems. Although teachers have revealed that assessing HOTS should not ignore the process or completion of problem-solving steps, when solving HOTS problem, most of them only write the final results and do not include the process of completion.

Conclusion

The results of this research indicate that not all teachers understand HOTS well. Teachers are still unable to distinguish HOTS from ability, skills, learning methods, learning models or learning activities. Teachers are already aware of the importance of HOTS for students. However, teachers' knowledge about the importance of HOTS still lacks good knowledge on learning and improving HOTS. Although teachers already know that students can be trained about HOTS, by using some learning models (e.g. problem-based learning, project-based learning, inquiry learning, cooperative learning), teachers still confuse activities in particular models of learning. The implementation of the Bloom's Taxonomy has also not been seen in teachers' responses for measuring and assessing HOTS. Moreover, the low level of teachers' knowledge on HOTS is also caused by their low ability in solving HOTS problems. The results of this study confirm that the low level of pedagogical abilities relating to HOTS is in line with the low ability of teachers' HOTS.

Although teacher is a key to the implementation of learning process, all educational bodies have equal responsibilities for improving education in the country. Results also reveal that teachers' pedagogical knowledge and HOTS are the main concern for educational advancement. Government and education experts should find solutions to solve this problem. Therefore, conducting socialization and teacher training on improving HOTS and its implementation in mathematics learning is one of the recommendations that should be applied. In addition, learning sources such as books, access to electronic media, or other sources still need further consideration by the government, schools and education experts.

Different types of research can be conducted but they should base on the findings of this research. The teachers' knowledge and skills need to be described more broadly and deeply so that it can be easy to identify any side to improve. The strategy to improve the quality of teachers, especially mathematics teachers, centers on professional and pedagogical competence. Similarly, the supporting media needs to develop so that teachers can have access to them in order to improve their qualification in managing and implementing innovative teaching and learning in their respective schools.

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PROBLEMS OF EDUCATION IN THE 21ST CENTURY

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PROBLEMS OF EDUCATION IN THE 21st CENTURY

TITLE OF ARTICLE: TEACHERS' KNOWLEDGE TOWARDS HIGHER-ORDER THINKING SKILLS AND ITS LEARNING STRATEGY

ID: 180103.pec_SA-sa_review PEC_2018-CFP

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1.	Is the article original, and does it contribute something new to the field? (Importance of article / Relevance and Appeal to national / international scholarly community)	Excellent	**Good**	Moderate	Poor
2.	Statement of problem (s) / aim (s) / objective (s)	Excellent	Good	**Moderate**	Poor
3.	Theoretical basis / Theoretical framework / Literature review / Clarification of concepts	Excellent	**Good**	Moderate	Poor
4.	Appropriateness of the research plan and design (if applicable) /Appropriateness of data-collection and procedure /Data analysis /Trustworthiness/ reliability and validity	Excellent	Good	Moderate	**Poor**
5.	Steps taken to ensure that the research complies with standard ethical guidelines (if applicable)	Excellent	**Good**	Moderate	Poor
6.	Data presentation / Discussion (Are the results clearly and correctly presented? Are they consistent with the methodology?)	Excellent	Good	Moderate	**Poor**
7.	To what extent is the line of argumentation in the article clear, cohesive and logical?	Excellent	Good	Moderate	**Poor**
8.	Does the paper satisfy accepted criteria for academic writing in terms of coherence, grammar, layout and organisation?	Excellent	Good	**Moderate**	Poor
9.	Do the references adhere to APA?	Excellent	Good	**Moderate**	Poor

10. Please write a brief narrative report on the article in which you provide a general or overall assessment of the manuscript and its suitability for publication.

General comments:

- The paper cannot be accepted for publication without re-write to clarify several aspects, mainly:
- Clarifying that the sample is enough to conduct the research and to generalize the findings on all teachers.
- Clarifying if this research should considered as a case study, or larger, and why or why not?
  As mentioned in "*The Type of Research*": This research is a case study, so how the researcher generalizes results?
- Clarifying the procedures of selecting the research sample "is it random? and how? And why private schools only?"
- Re-writing the whole section of data presentation and discussion to be more specific rather than using general terms.
- Modifying the whole paper by expert in English, mainly in issues related to "plural and single", examples:

- teachers also play an important role in education implementation considering their role as practicioner…
- are included in higher-order thinking skills…
- HOTS also plays
- HOTS is...

- Checking the APA6 style in mentioning resources, in cases like “these are examples only”:
  - …the 4CS mentioned by Scott, which…
  - …Moseley et al., 2005 (that was in all citations including the first one)

The title: The Researchers’ Role:

- The description here should be titled as the limitations of the study.
-

11. Please indicate the strong aspects of the research that is reported.

- There is a good effort in representing the research procedures.
- The overall paper is good in representing the work, mainly in: "aim, theoretical aspects, and procedures", and it might be overall good after real modifications and clarifications “mainly in dealing with results representation”.

12. Please indicate the weak aspects of the research reported.

As mentioned in General Comments:

- The paper Cannot be accepted for publication without re-write to clarify several aspects, mainly:
  - Clarifying the procedures of selecting the research sample "is it random? and how?"
  - Is this research a case study as mentioned? Then how can the researcher generalise results?
  - Clarifying the procedures of validations of the instrument "the test".
  - Rewriting the results presentations “avoid general terms: most, some, etc., they are only 10”
  - Rewriting the whole paper by expert in English.

13. Final recommendation:

Can be published	
Can be published provided that the suggested amendments are made	
Must be amended and resubmitted for evaluation	✓
Should be rejected	

14. Comments: Please indicate in the space below any comments and suggestions for improving the article.

If researcher/researchers are able to modify the paper to deal with the weakness mentioned above, it might be possible to accept the paper for publication due to the good literature review a general procedures, otherwise it should be rejected.

20 January 2018