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PROFIL PEMECAHAN MASALAH SISWA SMP DALAM MENYELESAIKAN SOAL PISA KONTEN UNCERTAINTY AND DATA BERDASARKAN PEMECAHAN MASALAH IDEAL

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Abstrak:
Penelitian ini bertujuan untuk mengetahui profil pemecahan masalah siswa dalam menyelesaikan soal PISA konten *uncertainty and data* berdasarkan pemecahan masalah IDEAL (*I-Identidy problem, D-Define goal, E-Explore possible strategies, A-Anticipate outcomes and act,* dan *L-Look back and learn)*. Jenis penelitian ini adalah penelitian kualitatif. Subjek dalam penelitian ini adalah 3 siswa kelas VIII SMP Negeri 1 Salatiga tahun pelajaran 2018/2019. Teknik pengumpulan data yang digunakan adalah tes, wawancara, dan dokumentasi. Berdasarkan hasil tes tertulis dan wawancara diperolehbahwa sebagian siswa mampu melaksanakan tahapan pemecahan masalah dengan runtut dan tepat, dan cenderung semua subjek kurang dalam tahap *explore strategies* dan *look and learning*.

Kata Kunci: Pemecahan Masalah IDEAL, Soal Matematika PISA, *Uncertainty and Data*

THE PROFILE OF JUNIOR HIGH SCHOOL STUDENTS' PROBLEM SOLVING IN ANSWERING THE CONTENT PISA TEST OF UNCERTAINTY AND DATA BASED ON IDEAL PROBLEM SOLVING

Abstract:
The study aims to find out the profile of junior high school students' problem solving in answering the content PISA test of uncertainty and data based on IDEAL (I-Identify problem, D-Define goal, E-Explore possible strategies, A-Anticipate outcomes and act, and *L-Look back and learn) problem solving. Three students of the third grade state junior high school (SMPN) 1 Salatiga of academic year 2018/2019 were selected as the subjects of this study. The study used test, interview, and documentation as data collection techniques. Based on the results of the written test and interview, it is found that some students were able to implement all problem solving stages appropriately and sequentially. The subjects tended to ignore 'exploring strategies' and 'look and learning' stages.*

Keywords*: IDEAL Problem Solving, PISA Mathematical Problem, Uncertainty and Data*

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One of the aims of teaching mathemathics in Elementary School and Junior High School is making the students to be able to solve the problem (National Education Department, 2006). Problem solving is also one of the goals of mathematics learning according to the National Council of Teachers Mathematics (2000). Problem solving is very important in mathematics, Branca in Hendriana, Rohaeti, and Sumarmo (2017) stated that problem solving is the heart of mathematics and is a general goal of learning mathematics. Kadir in Wahansari (2015) also revealed that problem solving skills can train students to think logically, analytically, systematically, critically and creatively. Therefore, problem solving must begin to be grown and accustomed to students as early as possible to practice problem solving skills in students through mathematics learning.

One of the measurements to see the ability to solve mathematical problems is to use the results of the PISA study (Aini & Siswono, 2014). PISA is an international standardized test that assesses three abilities literacy namely reading (*reading literacy*), mathematics (*mathematical literacy*), and science (*scientific literacy*) which are designed for the students aged 15 years old. There are four mathematical contents in PISA that are in accordance with the school curriculum, namely *change and relationship, space and shape, quantity* and *uncertainty and data* (OECD, 2014).

Change and relationship, namely a content relating to functions and algebra, including algebraic symbols, similarities and inequalities, descriptions of tables and graphs. *Space and shape* is thecontent which includes the visual and physical world such as patterns, the nature of an object, position and orientation, object representation, decoding and writing code, and navigation. The element of mathematics in this content is geometry. *Quantity* is the content related to measurement, calculation, number pattern, presenting and modeling something in numbers, and conducting the estimation. *Uncertainty and data* are the content related to statistics and opportunities that are often applied in society. The important concept of mathematics in this content is collecting data, analyzing the data and presenting the data, opportunities and inferences (Budiono, 2014).

Since 2000, Indonesia has followed the PISA, yet the results have not been satisfying. Indonesia is still ranked in the bottom 10 of the other countries (Iswadi, 2016); (Kertayasa, Zulkardi, & Somakim, 2014). The cause of the low PISA ranking in mathematical literacy in Indonesia is the weakness of the students' ability to answer PISA test. In this case, the students are less accustomed to do the problem solving process correctly through some stages namely understanding the problems, planning the problems, planning the problem solving, implementing the problem solving and checking the results of problem solving (Wardhani & Rumiyati, 2011). This is in line with the statement of one of the mathematics teachers at State Junior High School 1 Salatiga that most students have difficulty when dealing with questions about problem solving and difficulty of answering the questions that require completion steps.

One of the contents in PISA which can be used to measure mathematical problem solving abilities is *uncertainty and data* content, and this content can have a positive effect on student test results (Silva, Zulkardi, & Darmawijoyo, 2011). Besides this content is also the heart of mathematical analysis of various mathematical problems (OECD, 2015). Therefore, there should be a solution to the right problem solving steps to overcome the weakness of problem solving skills in students by using questions of *uncertainty and data* content.

Various models of problem solving can be used to overcome the problem solving ability of students, one of which is problem solving according to Bransford and Stein (1993), namely that problem solving solutions have the following steps as follows: (1) identifying problems, (2) defining goals, (3) exploring solutions, (4) implementing strategies, (5) reviewing and evaluating the effects of influences. The problem solving model introduced by Bransford and Stein (1993) is IDEAL or *IDEAL problem solving* that is used to improve the ability to think and solve a problem. IDEAL itself implies the meaning of *I-Identity problems, D-Define goals, E-Explore possible strategies, A-Anticipate outcomes and act,* and *L-Look back and learn*. According to Yanti & Syazali (2016) IDEAL problem solving model is a learning activity that teaches students to solve problems in order to increase students' understanding of material conceptually and procedurally.

Referring to the research conducted by Purnomo and Mawarsari (2014) the implementation of IDEAL problem solving has a positive impact in improving mathematical problem solving abilities. In line with Kartono in Annizar (2015), which stated that PISA-oriented problem-solving capabilities refer to processes and more specifically using IDEAL strategies. This is what

underlies the selection of IDEAL problem solving models to be used as a reference in reviewing PISA problem solving in this study. Likewise, it is reinforced by Annizar's statement (2015) which argued that the IDEAL model was chosen because this model is more detailed than the previous model such as Polya, in which the identification and in determining the problem objectives has become one part while at IDEAL it becomes two parts. Hence it can be found in which parts the students are experiencing difficulties. In addition to an international survey conducted by PISA, the assessment implemented to see the aspects of students' problem solving abilities is that by using the IDEAL problem solving model. Moreover, Susiana (2010) also mentions that the second step of IDEAL problem solving is *defining the goals* or identifying the goals in which solving problems from Polya does not exist. Consequently, it makes solving IDEAL problems become different from solving problems according to Polya.

Noticing the importance of the problem solving process in mathematics learning, it has turned to be the basis of this research to find out the problem solving in terms of IDEAL problem solving steps. Hence, this study applies PISA questions on *uncertainty and data* content. The problem that can be formulated in this study is how the profile of the problem solving for PISA questions is *uncertainty and data*content in terms of IDEAL problem solving.

RESEARCH METHOD

This study applied qualitative research method. The subjects in this study were 3 eighth grade students of state junior high school (SMPN) 1 Salatiga with a purposive sampling technique. Data collection techniques used were the tests using PISA questions *uncertainty and data* content, interview techniques based on IDEAL problem solving stages, and documentation techniques in the form of photos and the results of recording interviews with the subject. The main instrument in this study is the researchers themselves. Moreover, the supporting instruments of the research were in the form of (1) tests of PISA tests on *uncertainty and data* content consisting of three questions on different *uncertainty and data* content in the mathematical process. Those are the first questions were about *employing mathematical concepts, facts, procedures, and reasoning*, the second questions were related to *interpreting, applying and evaluating mathematical outcomes*, the third question was associated with *formulating situations mathematically*. They were different in the context and mathematical activities, namely the first question was data analysis and data display/ visualization, the second question was generating data, the third

question was the probability and conclusion, while (2) interview guidelines were based on the IDEAL problem solving stage.

FINDINGS AND DISCUSSION

The analysis results of PISA test of uncertainty and data content based on the worksheet results from three students (S1, S2, and S3) are presented based on the given test types as follows:

The analysis of the students work based on IDEAL stages in answering PISA test of Uncertainty and Data content by using Mathematical Processes of Employing Mathematical Concepts, Facts, Procedures, and Reasoning

The PISA test given to the students is as follows: In January, the new CDs from 4U2Rock band and The Kicking Kangaroos band have been released, followed by No One's Darling band and The Metalfolkies band in February. The chart below shows the CD sales from January to June.

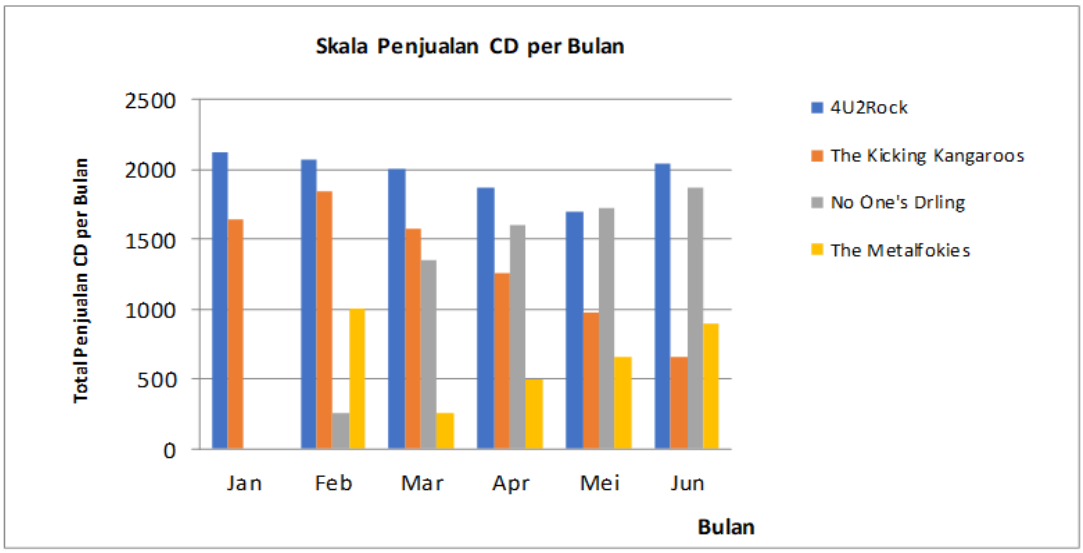

Figure 1. The Chart of CD Sales Scale in Every Month

The manager of The Kicking Kangaroos is worried because the CD sales are decreased from February to June. How much is the estimated sale volume in July if the same losses continue?

A. 70 CDs
B. 370 CDs
C. 670 CDs
D. 1340 CDs

Stage 1, Identify Problem

On this stage, S1 and S2 wrote what they had known in their answer sheets that can be seen sequentially on figure 2 and figure 3. S1 also wrote the main problem in the question namely "July?" It is confirmed in the following interview result:

P	:	So, what is the main problem of the test that has to be answered?
S1	:	The estimation of The Kicking Kangaroos' CD sales in July if the same losses continue.

The transcript of S1 interview in explaining the main problem of the test number 1

S2 explained the main problem on the test by adapting some sentences on the test. It is stated on the following interview:

P	:	So, what is the main problem of the test?
S2	:	The CD sales in July

The transcript of S2 interview in explaining the main problem of the test number 1

S3 explained what is known and the main problem in the test by using his own sentence found in the test. It is stated on the following interview result:

P	:	What do you know about the test?
S3	:	The various scales of CD sale chart from The Kicking Kangaroos band in every month which has almost the same decrease in every month.
P	:	So, what is the main problem that should be solved?
S3	:	The main point is to find out the sale volume estimation in July.

The interview transcript of S3 in formulating the stage of 'identify problem'

Stage 2, Define Goals

All subjects were able to determine the objective of the test by identifying which information or problem that should be solved. It was explained orally by those three subjects when interviewed. All subjects could determine the first step should be taken to answer the test by using different ways. S1 and S2

determined the sale scale in every month first, while S3 determined the difference of losses decrease in every month.

Stage 3, Explore Possible Strategies

Only S2 did this stage, while S1 and S3 were only able to fulfill two indicators namely, arranging the completion model or its completion plan and using the learned material in advance. When interviewed, S2 was able to explain the completion alternative by using other different method namely by using estimation through looking at the decrease on the chart then selected the closest scale. However, S2 preferred the first method because it was considered more definitely true, affective and appropriate.

Stage 4, Anticipate Outcomes anod Act

On this stage, all subjects had completed the test sequentially. Every subject has his own different ways in answering the test number 1. S1 sequentially wrote what is known and asked, and the answer of it was implied on the answer sheet, this can be seen on figure 2. S2 wrote the alleged sales first and looked for the difference in decrease then selected a, b, c, or d that was closest to his answer of 310, it can be seen on figure 3.

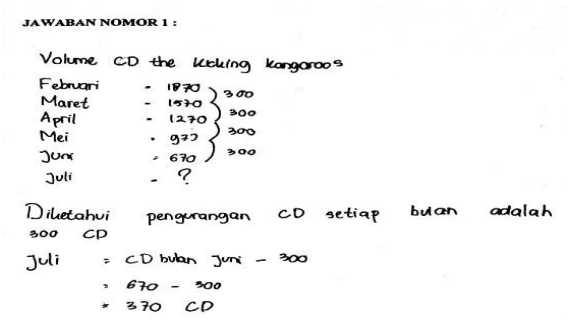

Figure 2. S1 Answer in Doing the Test Number 1

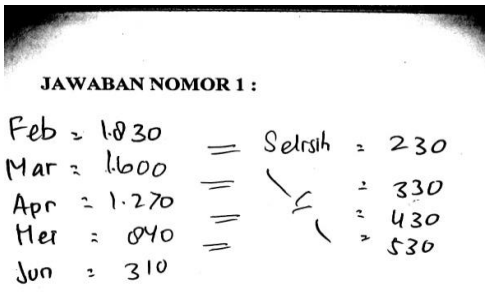

Figure 3. S2 Answer in Doing the Test Number 1

Stage 5, Look anod Learning

All subjects did not evaluate their answers for the test number 1 because the subjects felt confident about the answer.

The analysis of the students work based on IDEAL stages in answering PISA test of Uncertainty and Data content by using Mathematical Processes of Interpreting, Applying and Evaluating Mathematical Outcomes

The PISA test is presented as follows: For several weeks, Ivan deleted some photos and songs, but also added new photos and songs. The new storage status was 550 MB, Photos 338 Mb, and the free space storage was 112 MB. His brother gave him new empty memory card with the capacity of 2 GB (2000 MB). Ivan moved the content of the previous memory card into the new memory card.

Which of the following chart that shows the status of the new memory card? Circle A, B, C, or D.

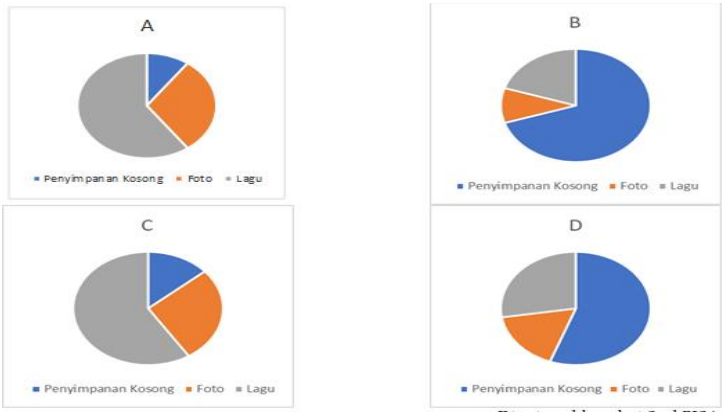

Figure 4. The Chart of the New Memory Card Status

Stage 1, Identify Problem

On this stage, all subjects were able to mention what is known on the test and they were able to explain the main problem needed to be solved. S1 and S2 wrote what is known on the answer sheet that can be seen on figure 5 and figure 6, while S3 formulated it by using his own sentence and adapted some of it from the test.

Stage 2, Define Goals

All subjects had conducted this stage and they were able to state the objectives of the test by showing the chart of the new memory card storage which was formulated through the words and they were able to determine the same first step (figure 5, figure 6, and figure7).

Stage 3, Explore Possible Strategies

On this stage, all subjects only fulfilled two indicators namely, by arranging completing plan by using first same step, but there was the difference in determining further plan in which S1 and S2 used presentation method, while

S3 used degree method. On the second indicator, all subjects had used materials that had been learned previously, one of them was the comparison material mentioned by those three subjects in advance. However, on the third and fourth indicators, all subjects could not find other method or other alternative to answer the test.

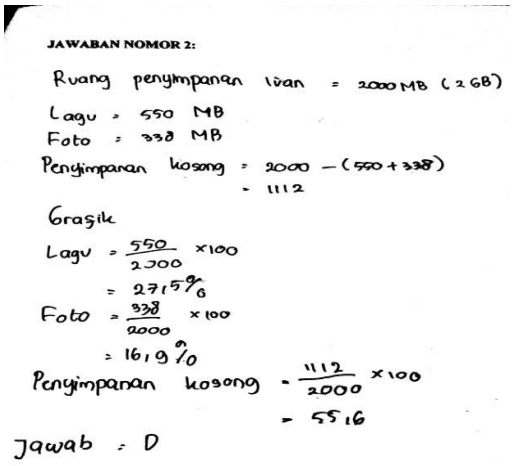

Figure 5. S1 Answer in Doing the Test Number 2

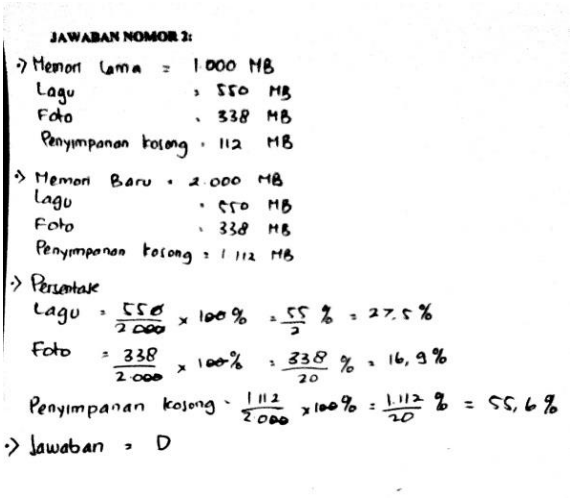

Figure 6. S2 Answer in Doing the Test Number 2

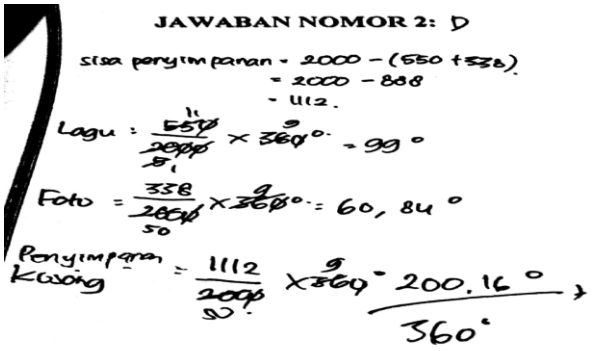

Figure 7. S3 Answer in Doing the Test Number 2

Stage 4, Anticipate Outcomes aand Act

All subjects had carried out completion appropriate with the previous plan. It can be seen on figure 5, 6, and 7 sequentially. S1 and S2 used presentation method, while S3 used degree method. All subjects had completed the test sequentially, started from determining the new memory card storage to finding other space storage and selecting the chart appropriate with its calculation. Therefore, all subjects could complete this stage.

Stage 5, Look aand Learning

On this stage, S1 did not do the evaluation or recheck his answer because he felt confident with it. S2 did the evaluation by re-ensuring whether the calculation is right or not; while S3 did the evaluation by checking the degree result from all storage spaces that if it was summed up, the result would be absolutely 360°. It can be seen on S3 answer in figure 7.

The analysis of the students work based on IDEAL stages in answering PISA test of Uncertainty and Data content by using Mathematical Processes of Formulating Situations Mathematically

The test is presented as follows. The Elektrix Company made two models of electronic devices: video player and audio player. In the last daily production, the player was tested and some broken ones were removed to be repaired.

The following table shows the average score of all player types made per day, and the average percentage of the broken players per day.

Table 1. The Average Numbers of Every Player Type Made Per Day, and the Average Percentage of the Broken Players Per Day

Player Model	The average numbers of the players made per day	The average Percentage of the broken players per day
Video Player	2000	5%
Audio Player	6000	3%

In this following, there are 3 conditions from daily production in Elektrix Company. Are those statements true?

Circle "Yes" or "No" on each statement.

Table 2. Provision of Daily Production at Elektrix Company

Statement	Is the statement true?
A third of the players produced every day are video players.	Yes / No
From every 100 produced video players, 5 of them are definitely failed products.	Yes / No

If the sound player is randomly selected from a production to try, the opportunity of the audio player needed to be repaired is 0.03.	Yes / No

Stage 1, Identify Problem

All subjects could formulate what was known in the test and mentioned the main problem in the test by using their own sentences and adapted some of the sentences from the test. It was explained by all subjects when interviewed. All subjects explained that on the written test there was Elektrix Company that made two models of electronic devices namely video and audio players. The video player was made per day about 2000 unit and the broken percentage was 5%, while the audio player was made per day about 6000 unit and the broken percentage was 3%. In addition, the subjects also explained the main problem what is meant in the test namely looking for the true or the false statement.

Stage 2, Define Goals

All subjects were able to complete this stage and they were able to explain the objective meant in the test namely determining the 'yes' or 'no' answer for those three statements. All subjects formulated their answers by using words. All subjects were also able to explain the first step done by using their own sentences, and used the same first step on the first statement namely by summing the video and the audio players. On the second statement, the subjects also used the same first step namely by firstly looking for 5% of the percentage from the broken video player per day. The last, on the third statement, S1 and S2 determined the average sum of audio player first, while S3 firstly analyzed the statement.

Stage 3, Explore Possible Strategies

All subjects conducted the first steps on the first statement by summing up the production of the audio and video players. Furthermore, S1 and S3 compared the total numbers of both players with the sum of both players, while on the second step, S3 multiplied 1/3 with the sum of both players. On the second statement, all subjects had the same completion plan by firstly looked for the broken audio player of 5% then it was multiplied by 100 if the number of production was 100 on the second statement. S1 and S2 did the same plan step on the third statement by determining the audio player then multiplied it with its broken average and the result of it was compared with the production

of the audio player, while S3 formulated the answer by adapting what was known in the test. All subjects also correlated the test with the learned material previously namely the comparison stated by those three subjects. On the indicator of exploring strategy, S1 and S2 did not find other step, while S3 used other step which was used by S1 and S2 on the first statement. Therefore, on this stage, only S3 completed the stage of 'explore possible strategies'.

Stage 4, Anticipate Outcomes aand Act

All subjects had implemented the strategy according to what was planned by the subjects. In addition, when interviewed them, all subjects were able to explain the strategy implementation steps in accordance with what had been written by the students/ subjects.

Stage 5, Look and Learning

On this stage, S2 and S3 rechecked their answers by ensuring whether the calculation was right or wrong. S1 did recheck his answer because he had been confident with his answer.

Related to the discussion above, there are differences with the working steps on each test type based on the IDEAL problem solving which is summarized on the following table 3.

Table 3. The Answering Method Differences of the Test Types Based on the IDEAL Problem Solving IDEAL

IDEAL Stages	Test Type 1			Test Type 2			Test Type 3		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
Identify problems	√	√	√	√	√	√	√	√	√
Define goals	√	√	√	√	√	√	√	√	√
Explore strategies	-	√	-	-	-	-	-	-	√
Anticipate outcomes	√	√	√	√	√	√	√	√	√
Look and learning	-	-	-	-	-	√	-	√	√

Based on the discussion and table 3, it can be seen that on the test type number 1, all subjects did not implement the stage of 'look and learning', while on the test type number 2, all subjects did not implement the stage of 'explore strategies'. On the test type number 3, only subject 3 was able to implement all five stages of IDEAL problem solving. It is contrary to the research conducted by Annizar (2015) who stated that the subject with high ability tended to answer

the test by using IDEAL problem solving, whereas in this study, only some subjects were able to implement all stages of IDEAL problem solving. It happened because there were differences in selecting the test/ question. In this study, the researchers selected uncertainty and data content through those three PISA test types, while Annizar (2015) used PISA test of problem solving type.

CONCLUSION

Based on the findings and discussion, it can be concluded that only some students/ subjects were able to implement the problem solving stages sequentially and appropriately, and all subjects tended to be less capable in implementing the stages of 'explore strategies' and 'look and learning' so that the teacher is expected to be able to familiarize the students in writing the problem solving sequentially, rechecking the answers, and train them to think creatively by exploring other possible answers.

REFERENCES

Aini, R. N., & Siswono, T. Y. E. (2014). Analisis pemahaman siswa SMP dalam menyelesaikan masalah aljabar pada PISA. *Jurnal Ilmiah Pendidikan Matematika*, *3*(2), 158–164. Retrieved from http://jurnalmahasiswa.unesa.ac.id/index.php/mathedunesa/article/view/8718/8768

Annizar, A. M. (2015). *Analisis Kemampuan pemecahan masalah soal PISA menggunakan model IDEAL pada siswa usia 15 tahun di SMA Nuris Jember*. Universitas Jember. Retrieved from http://repository.unej.ac.id/handle/123456789/73118

Bransford, J. D., & Stein, B. S. (1993). *The ideal problem solver* (2nd ed.). Duffield: Worth Publishers.

Budiono, C. S. (2014). Pembelajaran berbasis masalah berorientasi PISA berpendekatan PMRI bermedia LKPD meningkatkan literasi matematika peserta didik SMP. *Unnes Journal of Mathematics Education*, *3*(3), 210–219. Retrieved from https://journal.unnes.ac.id/sju/index.php/ujme/article/view/4487

Depdiknas. (2006). *Peraturan Menteri Pendidikan Nasional Republik Indonesia nomor 22 tahun 2006 tentang standar isi untuk satuan pendidikan dasar dan menengah*. Jakarta: Depdiknas.

Hendriana, H., Rohaeti, E., & Sumarmo, U. (2017). *Hard skills dan soft skills*

matematik siswa. Bandung: Refika Aditama.

Iswadi, H. (2016). Sekelumit dari hasil PISA 2015 yang baru dirilis. Retrieved from http://www.ubaya.ac.id/2014/content/articles_detail/230/Sekelumit-dari-Hasil-PISA-2015-yang-Baru-Dirilis.html

Kertayasa, I. K., Zulkardi, & Somakim. (2014). Achievement of indonesian student in assesment by using online mathematical problems. In *Proceeding the 2nd SEA-DR* (pp. 162 – 171). Palembang. Retrieved from http://eprints.unsri.ac.id/5203/1/I_Ketut_Kertayasa.pdf

National Council of Teachers Mathematics. (2000). *Principle and standart for school mathematics*. Reston, VA: NCTM.

OECD (Organisation for Economic Co-operation and Development). (2014). *Education at glance 2014: OECD Indicators*. Paris: OECD Publishing.

OECD (Organisation for Economic Co-operation and Development). (2015). *PISA 2015: assesment and analitical framework*. Paris: OECD Publishing.

Purnomo, E. A., & Mawarsari, V. D. (2014). Peningkatan kemampuan pemecahan masalah melalui model pembelajaran ideal problem solving berbasis project based learning. *Jurnal Karya Pendidikan Matematika*, *1*(1), 24–31. Retrieved from https://jurnal.unimus.ac.id/index.php/JPMat/article/view/1042/1096

Silva, E. Y., Zulkardi, & Darmawijoyo. (2011). Pengembangan soal matematika model PISA pada konten uncertainty untuk mengukur kemampuan pemecahan masalah matematika siswa sekolah menengah pertama. *Jurnal Pendidikan Matematika*, *5*(1). Retrieved from https://ejournal.unsri.ac.id/index.php/jpm/article/view/335/101

Susiana, E. (2010). Ideal problem solving dalam pembelajaran matematika. *Kreano: Jurnal Matematika Kreatif-Inovatif*, *1*(2), 73–82. Retrieved from https://journal.unnes.ac.id/nju/index.php/kreano/article/view/1491/1615

Wardhani, S., & Rumiyati. (2011). *Instrumen penilaian hasil belajar matematika SMP: belajar dari PISA dan TIMSS*. Yogyakarta: Pusat Pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan (PPPPTK) Matematika.

Wulansari, D. (2015). *Analisis kemampuan pemecahan masalah matematika suku*

banyak bagi siswa kelas XI IPA SMA Theresiana Salatiga. Universitas Kristen Satya Wacana Salatiga.

Yanti, A. P., & Syazali, M. (2016). Analisis proses berpikir siswa dalam memecahkan masalah matematika berdasarkan langkah-langkah Bransford dan Stein ditinjau dari adversity quotient.*Al-Jabar: Jurnal Pendidikan Matematika*, *7*(1), 63–74. Retrieved from http://ejournal.radenintan.ac.id/index.php/al-jabar/article/view/132/122