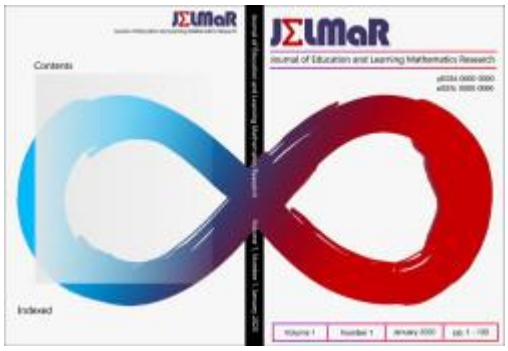

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Students' Reflective Abstraction in Solving Ethnomathematics-Based Mathematics Problems

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Abstract : *Reflective abstraction is a process of reflection on previously learned concepts and applied in new situations. The purpose of this study is to describe the reflective abstraction ability of junior high school students in solving math problems in terms of mathematical ability. In this study using qualitative research type. The data sources for this study were 4 students of class VIII, namely 2 students with high ability and 2 students with low ability. The results showed that students who have high ability, recognition level to remember and identify previous activities related to the problem at hand. At the representation level, students can translate information into mathematical models correctly. At the structural abstraction level, students can solve problems correctly, and are able to overcome difficulties in solving problems. At the structural awareness level, students are able to provide arguments about the results of the answers that have been done. While students with low ability, at the recognition level are able to remember previous activities related to the problem at hand. At the representation level, students are able to translate information into mathematical models, but students are less careful and wrong so that at the structural abstraction level students are able to solve problems, but the final results obtained are not correct. At the structural awareness level, students are able to solve and explain the steps in the problem. Based on the results of the study, teachers should guide students by providing problem exercises that can increase reflective abstraction, especially considering student responses and learning outcomes collected from high and low ability students. For this reason, further research needs to be carried out with other student data sources.*

Keywords: Reflective Abstraction, math skills, problem solving.

INTRODUCTION

Mathematics education is a field of study concerned with mathematics learning, teaching and research. Mathematics education covers various topics, including mathematics teaching and learning methods, mathematics assessment theory and practice, and curriculum development (Putra et al., 2023,p.119). Learning mathematics aims to make students understand how to solve problems. In addition, according to NCTM (National Council of Teachers of Mathematics, 1980), solving problems is the core of learning mathematics. Issues that exist at school can be in the form of trials designed to test students and should be able to be solved by students. Learning objectives can be achieved when students solve problems by overcoming difficulties (Sriwahyuni & Maryati, 2022,p.336).

Van de Walle (Putri & Santosa, 2015,p.264) defines problem-solving as a process in learning materials that provides a context in which concepts and skills can be learned. In other words, problem-solving skills can be honed through a mathematics learning process that involves students. Of course, this process will present a context in the form of mathematical problems. A question only automatically becomes problematic (Putri & Santosa, 2015,p.264). Mathematical problem-solving ability, according to Kesumawati, is the ability to determine what is known, what is asked and the completeness of the required elements, be able to create or compile mathematical models, be able to choose and develop solution strategies, be able to explain and check the correctness of the answer problems obtained (Mawaddah & Anisah, 2015,p.167). Students need the proper steps to make it

easier for students to solve problems properly and correctly. In the context of problem-solving, Polya has to solve steps or stages of problem-solving through several locations, namely: (1) understanding the problem, (2) planning problem solving, (3) implementing the problem-solving plan, (4) Looking back (Rossydha *et al*., 2021,p.1).

According to research results conducted by (Ekawati & Saragih, 2018,p.54), junior high school students have difficulty abstracting, incredibly reflective abstraction. This difficulty to abstract is different for each student, ranging from difficulty distinguishing numbers, difficulty distinguishing mathematical symbols, and inability to understand mathematical postulates. Students' difficulties when solving math problems can be overcome with abstraction skills (Sutrisna, 2021,p.27). With this abstraction ability it helps students to find ways or solutions in the absence of natural problem objects. According to (Kërënxhi & Gjoci, 2017,p.151). There are three types of abstraction: empirical abstraction, pseudo-empirical abstraction, and reflective abstraction.

Reflective Abstraction is the ability to generalize, formulate models, and understand mathematical concepts through critical thinking and reflection. Reflective Abstraction focuses on ideas about students' actions and activities. Wiryanto (2014) mentions that there are 4 levels of Abstraction, namely, the first level is recognition, the second level is representation, the third level is structural Abstraction, and the fourth or highest level is structural awareness. The reflective abstraction level is called a particular level because this level is one of the steps to identify and describe problem solvers paying attention to certain concepts when problem-solving (Wiryanto, 2014,p.572). From this, reflective Abstraction is a process of re-disclosing or projecting the theory of understanding obtained and reorganizing the structure created from the students' results to new situations. Ethnomathematics-based learning is used to make it easier to overcome students' reflective Abstraction in solving math problems.

Ethnomathematics is a field that studies how people from different cultures understand, verbalize and use cultural concepts related to mathematics so that ethnomathematics can learn how to understand mathematics, express and use artistic ideas that are described mathematically (Hariastuti R, 2017,p.28). Ethnomathematics learning is a practical approach to learning mathematics that improves concept understanding ability (Herawaty et al., 2019,p.21). One ethnomathematics that can be applied in learning mathematics is ethnomathematics in traditional games. The learning process is found in classic games, and traditional games have elements of mathematics, or in this case, it is called ethnomathematics. One or more people play traditional games with rules that players can change from conventional games (Rahmatul, 2017,p.30). Using ethnomathematics concepts in games can also be a teacher's teaching material so that students can be more interested in learning mathematics with cultural elements. The traditional game used is the congklak game; this congklak game is often used as an ethnomathematics-based learning media.

Traditional Games Congklak is a classic game with different names in each region, especially in the Java region; some call it songkok, and some call it dakon, dhakon, and dakonan. We can use the congklak game in math materials such as integers, circles, and opportunities. The congklak match is made of wood, but over time, the congklak game is now mostly made of synthetic plastic material. This game consists of 2 parent holes and 14 parent holes and seed shells to play this game. Congklak is a game played by two people facing each other. To play it is to fill each gap of the congklak child with 7 seeds each, then do a suit who wins then he plays first, how to play it by taking one of the seeds in the congklak hole then rotating clockwise by dividing each one of the congklak seeds in hand in each basin that are passed unless the barn basin is not filled. Every seed runs out, then the player takes the contents of the last hole, including the last source, and distributes it again. This continues until the player meets an empty hole and stops and continues with the other player. From how to play the game, there is a connection with learning mathematics, namely in class VIII chance material, which can determine the chances of events in the traditional game of congklak. For example, looking for the opportunity of congklak seeds falling into an empty hole, students will find it easier to understand opportunity material by linking it with this traditional congklak game.

Referring to the explanation above, the researcher is interested in applying students' reflective abstraction in solving ethnomathematics-based mathematical problems in the game of congklak and grade VIII chance material.

METHOD

Based on the background and objectives of the study, namely to describe students' reflective abstraction abilities in solving ethnomathematics-based mathematical problems in probability material. Therefore, this research uses a type of qualitative research with a descriptive approach that will answer research questions.

This research was conducted at SMP Negeri 2 Balung. This research takes data in the form of written answers made by data sources. The data sources in this study were VIII grade junior high school students and selected students with the criteria of 2 students who had high ability and 2 students who had low ability. Before testing the reflective abstraction of the data source, the researcher first discussed with the mathematics teacher at the school to be tested, namely related to students who have these criteria and seen from the students' daily test scores. After getting students who match the desired criteria, the researcher conducts a test by giving test questions to students. After the test questions were carried out, the researcher conducted interviews to find out the steps used by students when solving the given math problems. Interviews are conducted to see indicators that do not appear from the results of students' written tests.

Table 1. Indicators of Reflective Abstraction in Polya's Problem Solving

Problem Solving Steps	Level of Reflective Abstraction	Characteristics
Understanding the Problem	Recognizion	a. Read the problem/issue. b. How the attention to the problem is read, is it rather long, this shows its abstraction. c. How to reorganize the structure of the problem he is facing.
	Representation	Can distinguish between known and questioned
	Structural Abstraction	Abstracting the underlying structure of the problem, stating the relationship between what is known and what is asked.
	Structural Awareness	Express what is abstracted about what is known and what is asked
Planning the Problem Solving	Recognition	a. Re-recognize (remember) what is known and what is asked. b. Re-recognize (remember) the problem solving method that has already been solved.
	Representation	a. Did the student plan correctly? b. Has it represented in picture form and understood the structure of the problem.
	Structural Abstraction	a. Abstracting the structure that has been represented with symbols. b. Abstracting other alternative solution methods.
	Structural Awareness	Realizing and expressing what is abstracted about what is represented with mathematical symbols symbols
Implementing the Plan	Recognition	Re-recognize the structure of problems that have already been solved, and relate or compare to the problem situation at hand.
	Representation	a. Express the results of previous thinking in the form of diagrams, mathematical symbols, words, tables, graphs to aid reflection. b. Translate and transform information or structures into mathematical models

	Structural Abstraction	a. Reorganizing the structure of mathematical problems in the form of composing, organizing, and developing. b. Anticipating difficulties when using the previous method. c. Anticipating difficulties when using new methods.
	Structural Awareness	a. Being aware of the methods used. b. Realizing the results obtained need to be checked again.
Looking Back	Recognition	Re-recognize (remember) the results obtained.
	Representation	Representing the created structure but in a different way.
	Structural Abstraction	Summarize the final result by applying the structure that has been created.
	Structural Awareness	a. Realizing the decision/conclusion reached. b. Summarizing the problem-solving activity.

RESULT AND DISCUSSION

The results of discussions with mathematics teachers related to student criteria from student daily test results and obtained 4 students who meet the requirements used as research data sources, namely 2 students with high abilities and 2 students with low skills.

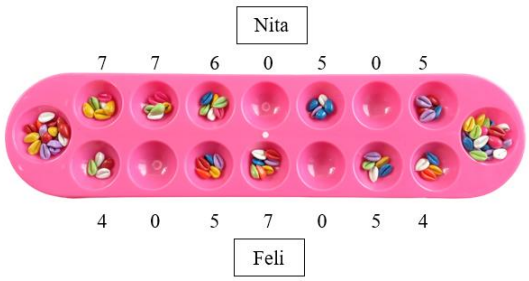
Table 2. Research data source code

No.	Student Code	Criteria
1.	KT1	High Ability 1
2.	KT2	High Ability 2
3.	KR1	Low Ability 1
4.	KR2	Low Ability 2

Table 3. Research indicator code

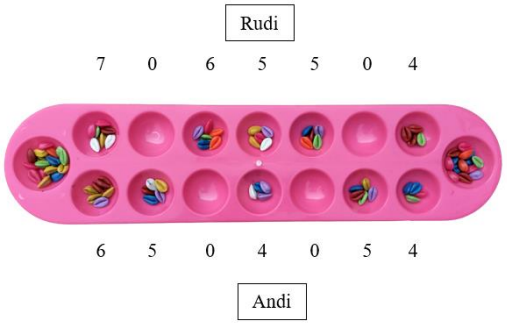
Code	Indicator
P1	Recognizion
R1	Representasion
A1	Structural Abstraction
K1	Structural Awareness

The following are 2 test questions used in this study to describe students' reflective



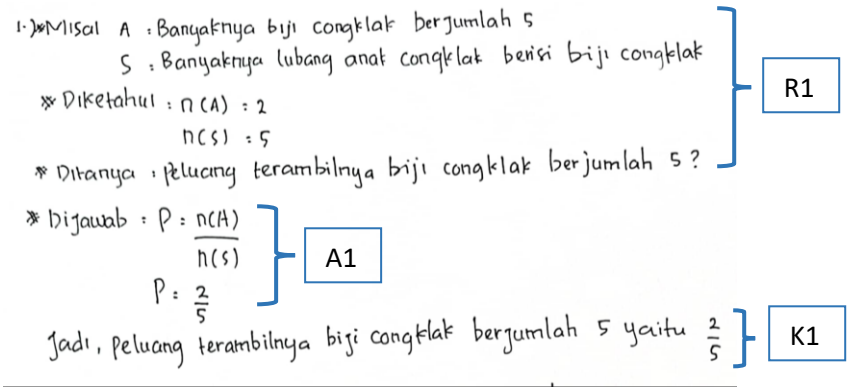
abstraction abilities in solving math problems.

1. Look at the picture below!
   On Sunday Feli and Nita played congklak in front of Nita's house. Then it is Feli's turn to play congklak, and Feli will take 5 seeds. What is the probability that Feli will pick up 5 congklak?



2. Take a look at the picture of the congklak game below!

Rudi and Andi are playing congklak together on a holiday, then in the middle of the congklak game (as in the picture above), what is the chance that Rudi and Andi's congklak seeds will fall into an empty hole?



Results

Analysis of KT1 Data Reflective Abstraction in Solving Mathematical Problems question number 1

Figure 1. KT1's answer to question number 1

Based on the answer of data source KT1 in Figure 1, it can be seen that data source KT1 wrote down the known information in the problem given. Data source KT1 also mentions what is known correctly, namely, n(A)=2 and n(s)=5, and students know what is asked in the problem, namely "the chance of taking 5 congklak seeds? Data sources are written in stages so that they facilitate the process of working and do not take a long time. Based on the answers of the KT1 data source in Figure 1, it can be seen that the KT1 data source wrote down the known information in the problem given. The KT1 data source also mentions what is known correctly, namely, n(A)=2 and n(s)=5, and students know what is asked in the problem, namely "the chance of picking up 5 congklak seeds". Data sources are written in stages so that they facilitate the process of working and do not take a long time. And the data source worked and wrote the formula well and correctly.

And the results of the KT1 data source interview are as follows

P : Did you have trouble reading the problem?
KT1 : No, sis,
P : Have you ever done a problem like this before?
P1
KT1 : Never
P : What do you remember?
KT1 : Making an initialization for the number to find and the number of samples.
P : Can you restate what is known in the problem?
KT1 : know kak for the known number of congklak seeds totaling 5 it is in the The picture of the congklak given in the feli section is 2. And for the number
R1

of the sample is also in the picture, namely the small hole filled in the feli section, which is 5. that is, there are 5. — R1

P : What method did you use in solving the problem?

KT1 : Using the odds formula, $P = \frac{n(A)}{n(S)}$, then inputting what is known before in the formula. known before in the formula. — A1

P : Then there are no difficulties in solving this problem?

KT1 : There is, because what is known is not written directly in the problem but in the picture given. the picture given.

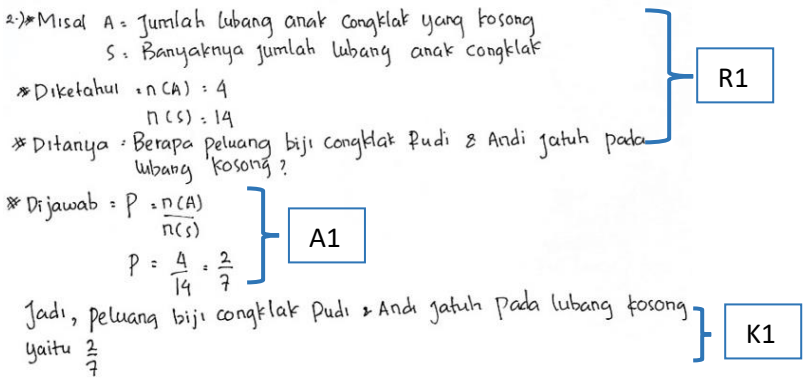
P : Then how did you overcome that difficulty?

KT1 : I looked back at what was in the picture so that I found what was known. known kak.

P : Try to explain again how you worked on the problem given!

KT1 : First, I read the problem first and then generalize the problem such as the number of seeds totaling 5 is initialized with the letter A, and the number of holes of the child's congklak filled with the letter s, then look for what is known in that is n(A)=2, n(s)=5, and then put it in the probability formula which is P=$\frac{n(A)}{n(S)}$, $p = \frac{2}{5}$ so the probability of feli taking 5 congklak seeds is $\frac{2}{5}$ sist. — K1

Based on the results of the interview, data source KT1 had no difficulty in understanding the problem in the problem and had solved problems like this before. The data source remembers the problems he has previously solved by explaining how he got what he knew in the congklak picture. The data source also explained using the formula and how to work on it. The data source also explained the difficulty he got when looking for the known. The KT1 data source also explained the steps he used to solve the given problem.



Analysis of KT1 Data Reflective Abstraction in Solving Mathematical Problems question number 2

Figure 2. KT1's answer to question number 2

Based on the answer of data source KT1 in Figure 2, it can be seen that data source KT1 wrote down the known information in the problem given. Data source KT1 also mentioned what was known correctly, namely, n(A)=4 and n(s)=14, and students knew what was asked in the problem, namely, "What is the chance that Rudi and Andi's congklak seeds fall into an empty hole?". KT1 data sources are also written in stages so that it makes the process of working easier and does not take a long time. And the data source worked and wrote the formula well and correctly.

And the results of the KT1 data source interview are as follows

P : Did you have trouble reading the problem?

KT1 : No, sis,

P : Have you ever done a problem like this before?

KT1 : Never — P1

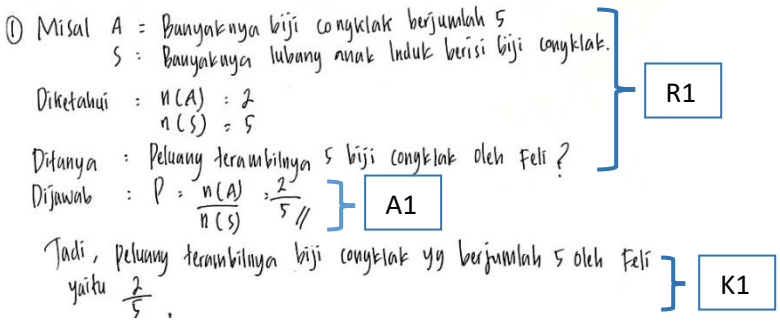
P : What do you remember?
KT1 : I made an equation first for the number to find and the number of samples.
P : Can you restate what is known in the problem?
KT1 : Know kak for what is known as the number of empty congklak seeds in the picture. Namely, there are 4, And for the number of samples, the number of holes of the congklak children is 14.
P : What method did you use in solving the problem?
KT1 : Using the odds formula, $P = \frac{n(A)}{n(S)}$, then inputting what is known before in the formula.
P : Then there are no difficulties in solving this problem?
KT1 : no kak
P : Try to explain again how you did the problem given!
KT1 : First I read the problem first and then generalize the problem such as the number of empty congklak holes is initialized with the letter A, and The number of filled congklak holes with the letter s, then look for known in that n(A)=4, n(s)=14, then put it in the odds formula which is , $P = \frac{n(A)}{n(S)}$", , $P = \frac{2}{7}$, so, the odds of andi and rudi's congklak seeds falling into empty holes are rudi that fall into the empty hole is $\frac{2}{7}$ sist.

R1

K1

Based on the results of the interview, data source KT1 had no difficulty in understanding the problem in the problem and had solved problems like this before. The KT1 data source remembers the problems he has previously solved by explaining how he got what he knew in the congklak picture. The data source also explained using the formula and how to work on it. The KT1 data source also explained the steps he used to solve the problem given and strengthened the answer by adding the sentence, "So, the chance of Andi and Rudi's congklak seeds falling into the empty hole is $\frac{2}{7}$ ".

From the results of the written test and interview above, the data source KT1 in questions number 1 and 2, KT1, can be said to meet the criteria for reflective abstraction level in solving math problems. At the recognition level, he knows the problem he is facing and has worked on the same problem before. At the second level of representation, KT1 explained how he found what he knew and asked. At the structural abstraction level, he used the formula correctly and explained the difficulty in finding what was known in problem number 1. For problem number 2, KT1 found no difficulty in solving the problem in the problem. At the last level of structural awareness, data source KT1 can re-explain the steps that have been completed and can conclude the final results in the test questions and interviews. Therefore, the KT1 data source fulfills the reflective abstraction level in solving math problems.



Analysis of KT2 Data Reflective Abstraction in Solving Mathematical Problems question number 1

Figure 3. KT2's answer to question number 1

Based on the answers of data source KT2 in Figure 3, it can be seen that data source KT2 wrote down the known information in the problem given. KT2 data sources also mention what is known correctly, namely, n(A)=2 and n(s)=5, and students know what is asked in the problem, namely, "the chance of Feli taking 5 congklak seeds?". Data sources are written in stages so that they facilitate the process of working and do not take a long time. And the data source works and writes the formula well and correctly.

And the results of the KT2 data source interview are as follows

P : Did you have trouble reading the problem?
KT2 : No, sis,
P : Have you ever done a problem like this before?
KT2 : Never kak
P : What do you remember?
KT2 : I made a problem first, namely the number of 5 seeds is denoted by A, and the number of samples or holes of the congklak child which is filled is denoted by the letter S.

P1

P : Can you restate what is known in the problem?
KT2 : I can, for what is known is in the congklaknya picture, namely the number of congklak seeds totaling 5 is in the picture of the congklak on the feli side that is, there are 2. And the number of small holes filled in the feli section is 5.

R1

P : What method did you use in solving the problem?
KT2 : Using the odds formula, $P = \frac{n(A)}{n(S)}$.
P : Then there are no difficulties in solving this problem?
KT2 : No, maybe in finding the known value, I have to be more careful. because it is found in the congklaknya picture.
P : Try to explain again how you did the problem given!
KT2 : First I generalize the problem as the number of congklak seeds totaling 5 let's say A, and the number of holes filled with congklaks with S, then find the known in that is n. with S, then look for what is known in that n(A)=2, n(s) = 5, then put it in the odds formula which is $P = \frac{n(A)}{n(S)}$, $P = \frac{2}{5}$, *so the result of the probability of feli taking 5 congklak seeds is* $\frac{2}{5}$ *kak.*

K1

Based on the results of the interview, the data source KT2 did not find difficulties in understanding the problem in the problem because he had previously solved problems like this. The data source remembered the problem he had previously solved by explaining how he got what KT2 knew in the congklak picture. The data source also explained using the formula and how to work on it. The KT2 data source also explained the steps he used to solve the natural problems of the test questions given properly and correctly.

Analysis of KT2 Data Reflective Abstraction in Solving Mathematical Problems question number 2

Figure 4. KT2's answer to question number 2

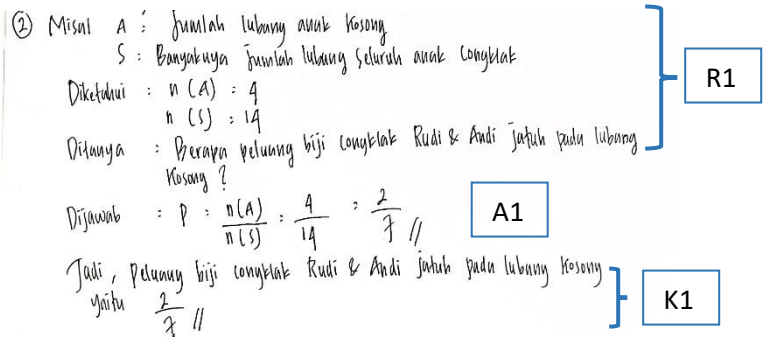
Based on the answer of data source KT2 in Figure 4, it can be seen that data source KT2 wrote down the known information in the problem given. KT2 data source also mentioned what was known correctly, namely, n(A)=4 and n(s)=14, and KT2 knew what was asked in the problem, namely "the chance of Rudi and Andi's congklak seeds falling into empty holes?". The KT2 data source also wrote in stages so that it made the process of working easier and did not take a long time. And the data source worked and wrote the formula well and correctly.

And the results of the KT2 data source interview are as follows

P : Did you have trouble reading the problem?
KT2 : No, sis,
P : Have you ever done a problem like this before?
KT2 : Never kak
P : What do you remember?
KT2 : I made the problem first, namely the number of congklak seeds that are empty. Empty is denoted by the letter A, and the number of samples or holes is denoted by the letter S. congklak children is denoted by the letter S.
P : Can you restate what is known in the problem?
KT2 : I can, for what is known is in the congklaknya picture, namely the number of empty congklak seeds is 4 listed in the picture given and the number of small holes is 7.
P : What method did you use in solving the problem?
KT2 : Using the odds formula, $P = \frac{n(A)}{n(S)}$,
P : Then there are no difficulties in solving this problem?
KT2 : No, maybe in finding the known value, I have to be more careful. because it is found in the congklaknya picture.
P : Try to explain again how you did the problem given!
KT2 : First, I generalize the problem first, such as the number of empty congklak seeds A, and the number of holes in the congklak with the letter S, then find the known in the holes with the letter S, then find what is known in the problem, namely n(A)=4, n(s)=14, then put it in the odds formula which is $P = \frac{n(A)}{n(S)}, P = \frac{2}{7}$ *so the result of the probability of the congklak seed falling into the empty hole is* $\frac{2}{7}$ *sist.*

P1
R1
K1

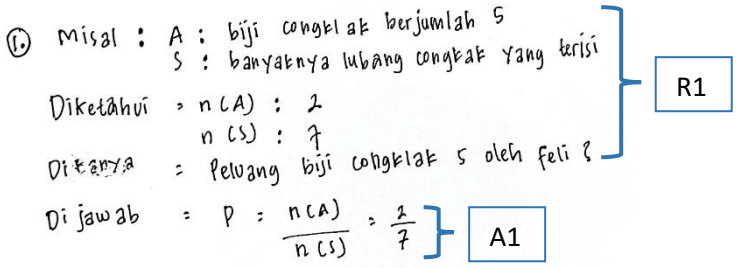
Based on the results of the interview, the data source KT2 did not find difficulties in understanding the problem because he had previously solved problems like this. The data source remembered the problem he had previously solved by explaining how he got what KT2 knew in the congklak picture. The KT2 data source is also explained using the formula



R1
A1
K1

and how to work on it. The KT2 data source also explained the steps he used to solve the problem in the test problem given properly and correctly.

From the results of the written test and interview above, the KT2 data source in questions 1 and 2 fulfills the reflective abstraction level in solving math problems. Because in his work, according to the parts of the reflective abstraction level, namely at the recognition level, he knows the problem he is facing and has worked on the same problem before. At the second level of representation, KT2 explained how he found what he knew and asked, and at the structural abstraction level, he used the formula properly and correctly. At the last level of structural awareness, data source KT2 can re-explain the steps that have been completed and can strengthen the final result. Therefore, data source KT2 fulfills 4 levels of reflective abstraction in solving math problems.



So it can be concluded that the reflective abstraction of KT1 and KT2 above can be said to be valid, so that KT's reflective abstraction ability meets all indicators of reflective abstraction levels, including at the recognition level KT students know and have no difficulty when reading the problem at hand. At the representation stage, KT students are able to explain what they know and what is asked in the problem they are working on and mention it correctly. At the structural abstraction stage, students are able to solve the problem by using the correct formula. In the last stage, namely structural awareness, students are able to explain and conclude the results of the answers that have been done before well and correctly.

Analysis of KR1 Data Reflective Abstraction in Solving Mathematical Problems question number 1

Figure 5. KR2's answer to question number 1

Based on the answer of data source KR1 in Figure 5, it can be seen that data source KR1 wrote down the known information in the problem given. But the KR1 data source mentions what is known incorrectly, namely, n(A)=2 and n(s)=7, but KR1 knows what is asked in the problem, namely "the chance of 5 congklak seeds by Feli". The data source was written in stages so that it made the process easier and did not take a long time. However, there were errors and a lack of accuracy in finding what was known, so the final result obtained was not appropriate.

And the results of the KR1 data source interview are as follows

P : Did you have trouble reading the problem?
KR1 : yes, sis,
P : What difficulties did you find?
KR1 : How to find what is known kak
P : How do you overcome these difficulties?
KR1 : I read the question over and over again.
P : Have you ever done a problem like this before?
KR1 : I have, but I forgot a little.
P : What do you remember?
KR1 : I made an equation first to make things easier.
P : Can you restate what is known in the problem?

KR1 : I can, for what is known is in the congklaknya picture, namely the number of congklak seeds totaling 5 is in the picture of the congklak on the feli side that is, there are 2. And the number of small holes filled in the feli section is 7.

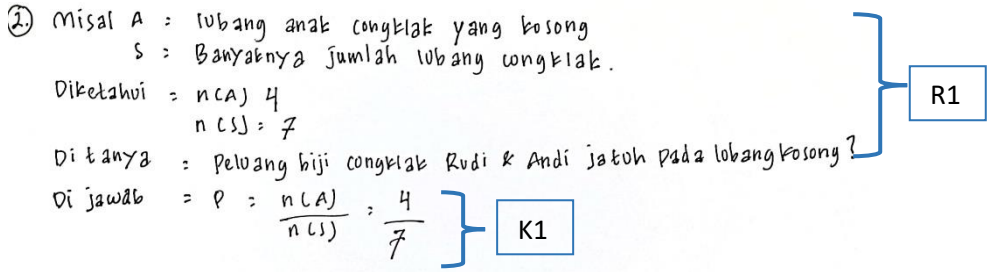
P : What method did you use in solving the problem?

KR1 : Using the odds formula $P = \frac{n(A)}{n(S)}$,

P : Explain again how you did the given problem!

KR1 : First I generalize the problem as the number of congklak seeds totaling 5 Let's assume A, and the number of filled holes of the congklak with S, then find what is known in A. with S, then look for what is known in that n(A)=2, n(s)=7, then put it in the odds formula which is $P = \frac{n(A)}{n(S)}$, $P = \frac{2}{7}$.

Based on the results of the interview, KR1 data sources found difficulties in



understanding the problem, namely in determining the known things, and KR1 had done the same problem before but forgot a little. The data source remembers the problem he had previously solved by explaining how he got what was known in the congklak picture, but the mention of what was known by the data source was wrong. The data source also explained using the formula and how to work on it. KR1 data source also explained the steps he used to solve the natural problems of the test questions given. The steps were correct, but the mention of the known numbers was wrong, so the final results obtained were not correct.

Analysis of KR1 Data Reflective Abstraction in Solving Mathematical Problems question number 2

Figure 6. KR1's answer to question number 2

Based on the answer of data source KR1 in Figure 6, it can be seen that data source KR1 wrote down the known information in the problem given. However, KR1 data source mentioned the known information incorrectly, namely, n(A)=4 and n(s)=7, but KR1 knew what was asked in the problem, namely "the chance of Rudi and Andi's congklak seeds falling into an empty hole?". KR1's data source was written in stages so as to facilitate the process of working and did not take a long time. However, there were errors and a lack of accuracy in finding what was known, so the final result obtained was not appropriate.

And the results of the KR1 data source interview are as follows

P : Did you have trouble reading the problem?

KR1 : yes, sis,

P : What difficulties did you find?

KR1 : How to find what is known kak

P : How do you overcome these difficulties?

KR1 : I read the question over and over again.

P : Have you ever done a problem like this before?

KR1 : I have, but I forgot a little.

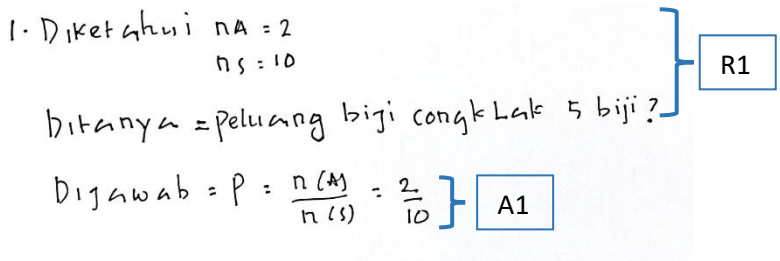
P : What do you remember?

K1

KR1 : I made an equation first to make things easier.
P : Can you restate what is known in the problem?
KR1 : I can, for what is known is in the congklaknya picture, namely the number of congklak seeds totaling 5 is in the congklak picture on the feli side and the number of small holes filled in the feli section is 7.
P : What method did you use in solving the problem?
KR1 : Using the odds formula $P = \frac{n(A)}{n(S)}$
P : Explain again how you did the given problem!
KR1 : First I generalize the problem as the number of empty congklak seeds Let's assume A, and the number of holes in the congklak with S, then look for what is known in which is n(A)=4, n(s)=7, Then then put it in the probability formula which is $P = \frac{n(A)}{n(S)}$, *is* $P = \frac{4}{7}$ kak.

Based on the results of the interview, the KR1 data source found difficulties in understanding the problem, namely in determining the known things, and KR1 had done the same problem before but forgot a little. The data source remembers the problem he has previously solved by explaining how he got what is known in the congklak picture, but the mention of what is known by the data source is wrong. The data source also explained using the formula and how to work on it. KR1 data source also explained the steps he used to solve the natural problems of the test questions given. The steps were correct, but the mention of the known numbers was wrong, so the final results obtained were not correct.

From the results of the written test and interview above, the KR1 data source in numbers 1 and 2 can be said to have not fulfilled all levels of reflective abstraction in solving math problems because several levels of abstraction have not been fulfilled. At the recognition level, KR1 knows the problem he is facing and has worked on the same problem



before, but he finds difficulty in reading the problem and what is known in the problem. At the second level of representation, KR1 explained how he found what he knew and asked, but what KR1 wrote and mentioned was wrong, so it did not fulfill the second level of abstraction and at the structural abstraction level using the correct chance formula. At the last level of structural awareness, KR1 data source can re-explain the steps that have been completed, but because of the error in the second step, the final result obtained is not correct. Therefore, the KR1 data source cannot be said to fulfill the 4 levels of reflective abstraction in solving math problems.

Analysis of KR2 Data Reflective Abstraction in Solving Mathematical Problems question number 1

Figure 7. KR2's answer to question number 1

Based on the answer of the KR2 data source in Figure 7, it can be seen that the KR2 data source wrote down the known information in the given problem. However, KR2 data source mentioned the known information incorrectly, namely, n(A)=2 and n(s)=10, but KR2 knew what was asked in the problem, namely "the chance of a 5-seed congklak seed". The data source wrote the solution in no detail, so it wasn't easy to do the working process. In solving the problem, there were

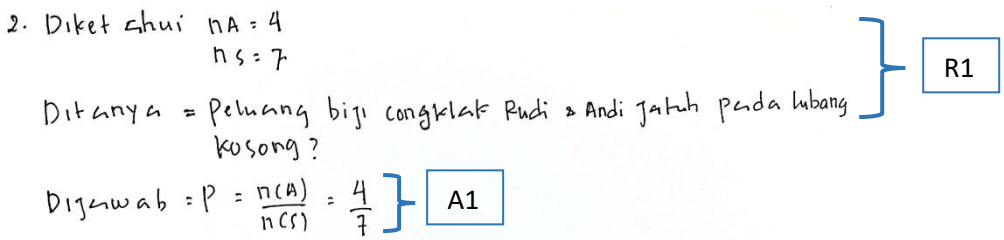
errors and a lack of accuracy in finding what was known, so the final result obtained was not appropriate.

And the results of the KR2 data source interview are as follows

P : Did you have trouble reading the problem?
KR2 : yes, sis,
P : What difficulties did you find?
KR2 : How to generalize and how to find what is known kak.
P : How do you overcome these difficulties?
KR2 : I read the question over and over again.
P : Have you ever done a problem like this before?
KR2 : I have, but I forgot a little.
P : What do you remember?
KR2 : The formula, sis.
P : Can you restate what is known in the problem?
KT2 : I can, for what is known is in the congklaknya picture, namely the number of empty congklak seeds totaling 5 is in the picture of the congklak in the feli section, there are 2. And the number of small holes filled is there are 10.
P : What method did you use in solving the problem?
KR2 : Using the odds formula, $P = \frac{n(A)}{n(S)}$
P : Explain again how you worked on the problem given!
KR2 : First I look for what is known in the problem, namely n(A)=2, n(S)=10,

R1

K1



Then put it in the odds formula which is $P = \frac{n(A)}{n(S)}, P = \frac{2}{10}$.

Based on the results of the interview, KR2 data sources found difficulties in understanding the problem, namely in determining the known things, and KR2 had done the same problem before but forgot a little. The data source remembers the problem he has previously solved by mentioning what is known in the congklak picture, but the mention of what is known by the KR2 data source is wrong. The data source also explained using the formula and how to work on it. KR2 data source also explained the steps he used to solve the problem in the given test problem. The steps were correct, but the mention of the known numbers was wrong, so the final result obtained was not correct.

Analysis of KR2 Data Reflective Abstraction in Solving Mathematical Problems question number 2

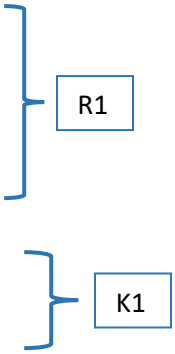
Figure 8. KR2's answer to question number 2

Based on the answer of the KR2 data source in Figure 8, it can be seen that the KR2 data source wrote down the known information in the given problem. However, KR2 data source mentioned the known information incorrectly, namely, n(A)=4 and n(s)=7, but KR2 knew what was asked in the problem, namely "the chance of Rudi and Andi's congklak seeds falling into an empty hole?". KR2 data source wrote the solution in no detail, so it wasn't easy to do the working process. In solving the problem, there were

errors and a lack of accuracy in finding what was known, so the final result obtained was not appropriate.

And the results of the KR2 data source interview are as follows

P : Did you have trouble reading the problem?
KR2 : yes, sis,
P : What difficulties did you find?
KR2 : How to generalize and how to find what is known sis.
P : How do you overcome these difficulties?
KR2 : I read the question over and over again.
P : Have you ever done a problem like this before?
KR2 : I have, but I forgot a little.
P : What do you remember?
KR2 : The formula, sis.
P : Can you restate what is known in the problem?
KT2 : I can, for what is known is in the picture of the congklaknya sist, namely the number of congklak seeds is 4. And the number of small holes that are filled in there are 7.
P : What method did you use in solving the problem?
KR2 : Using the odds formula, $P = \frac{n(A)}{n(S)}$,
P : Explain again how you worked on the problem given!
KR2 : First I look for what is known in the problem, namely n(A)=4, n(S)=7, Then put it in the odds formula which is $P = \frac{n(A)}{n(S)}$, $P = \frac{4}{7}$ sis.



Based on the results of the interview, KR2 data sources found difficulties in understanding the problem, namely in determining the known things, and KR2 had done the same problem before but forgot a little. The data source remembers the problem he has previously solved by mentioning what is known in the congklak picture, but the mention of what is known by the KR2 data source is wrong. KR2 data source also explained using the formula and how to work on it. KR2 data source also explained the steps he used to solve the problem in the given test problem. The steps were correct, but the mention of the known numbers was wrong, so the final result obtained was not correct.

From the results of the written test and interview above, the KR2 data source in questions number 1 and 2 has not all fulfilled the reflective abstraction level in solving math problems. Because several levels of abstraction have not been fulfilled. At the recognition level, KR1 knows the problem he is facing and has worked on the same problem before, but he finds difficulty in reading the problem and what is known in the problem. At the second level of representation, KR2 explained how he found what he knew and asked, but what KR2 wrote and mentioned was wrong, so it did not fulfill the second level of abstraction, and at the structural abstraction level used the odds formula correctly. At the last level of structural awareness, KR2 data source can re-explain the steps that have been completed, but due to errors in the steps in mentioning what is known to be wrong, the final results obtained are not correct. Therefore, the KR2 data source cannot be said to fulfill the 4 levels of reflective abstraction in solving mathematical problems.

So it can be concluded that the reflective abstraction of KT1 and KT2 above can be said to be invalid, so that KT's reflective abstraction ability cannot be said to meet all indicators of reflective abstraction levels, including at the recognition level KT students have difficulty when reading the problem at hand. At the representation stage, KT students are able to explain what they know and what is asked in the problem they are working on, but they mention it wrong. At the structural abstraction stage, students are able to solve problems using the correct formula. Still, in the second stage, they are wrong, so in this third stage,

students solving problems become inappropriate. In the last stage, namely structural awareness, students are able to explain and conclude the results of the answers that have been done before.

Discussion

Based on the results of research data on reflective abstraction of junior high school students in solving math problems in terms of high mathematics ability and low mathematics ability. The following is a discussion on this research.

Reflective Abstraction of Students with High Mathematical Ability in Solving Mathematics Problems

At the recognition level, students with high mathematics abilities 1 and 2 can recall previous activities related to the problems they face, students reveal that the problems they face are different from the problems they have encountered before. In addition, students can identify which concepts to use, starting from asking first, investigating and asking questions, and using formulas to the final results obtained. Students choose the concept used to solve the problem. Wiryanto's (2014) opinion is that when students face a problem, they bring up the concept behind the problem.

At the representation level, students with high mathematical ability are able to translate and transform the information contained in the problem into a mathematical model. This is in accordance with the opinion of Ulia *et al*., (2018,p.109) At the representation level, students can express the results of their thinking in the form of mathematical symbols, images, tables or graphs according to the problem at hand. From the research conducted, students with high mathematical ability 1 and 2 were able to write down the results of their thinking in the form of mathematical symbols. By presenting the information known in the math problem.

At the structural abstraction level, students with high mathematics ability 1 and 2 can write down the results of the representations that have been done before and continue solving the problems presented. From the results of their work, students with high ability are able to determine the right formula so that they can solve the final result correctly. Besides that, students do not experience difficulties but students say they have to be careful and read repeatedly in order to understand it. In accordance with the opinion of Bachtiar & Susanah, (2021,p.276) This shows that at the structural abstraction level, students solve certain problems based on the results of previous representations.

At the structural awareness level, students with high mathematical ability can argue about the procedures followed to solve the problem. Students can explain the steps in solving problems that were done before. This is in accordance with the statement from Ulia *et al*., (2018,p.109) structural awareness is the disclosure of students to provide reasons for the answers that have been done.

Reflective Abstraction of Students with Low Mathematical Ability in Solving Mathematics Problems

At the recognition level, low ability students can recall previous activities related to the problem at hand. Students can also remember what was written when solving the problem. Thus with the statement of Fajriyah & Susanah, (2018,p.469) at the introduction level students will try to find concepts that can be used in solving problems. In the process of identifying students are able to explain the steps that have been done before.

At the representation level, students can transfer previous activities to new situations. Students also write information using mathematical symbols, namely when students look for things that are known, students are less careful in understanding the problem so that the results obtained are not correct, but students can explain what is known in the problem. So that low mathematical ability students cannot fulfill the second level of abstraction.

At the structural abstraction level, students with low mathematical ability can solve the problems provided. This is in accordance with Wiryanto's opinion (2014) at the third level

students begin to solve problems with previous representations. However, students fail to develop strategies to solve problems. Students also have difficulty in understanding the problem, but can solve it repeatedly, but the answers obtained are still not correct.

At the structural awareness level, students present arguments about how to solve a problem that they use. Students use the answers obtained for new problems. Supported by the opinion of Mustikarini, (2020, p.15), at the structural awareness level students can solve new problems that are similar to the problems they have just encountered. And students can explain the steps and conclude the results they have done before.

So, from the discussion of reflective abstraction above, it can be concluded that students who have high abilities, namely KT1 and KT2, can be said to meet all the criteria for reflective abstraction levels, while students who have low abilities, namely KR1 and KR2, cannot be said to meet all the criteria in the level of reflective abstraction in solving mathematical problems.

CONCLUSION

Reflective abstraction of high-ability students at the recognition level, students are able to identify the concepts used to solve problems. Students can also remember the problems that have been done. At the representation level, students can write down the known information on the answer sheet with a mathematical model. At the structural abstraction level, high-ability students can solve problems and develop strategies to solve them. At the structural awareness level, students are able to explain each step used in solving the problem.

Reflective abstraction of students who have low ability at the recognition level, students are able to systematically remember what was done when given questions about chance material. Students can identify the problems given, but there are errors and a lack of thoroughness in understanding the problems given, so, at the level of representation, students in writing what is known is not correct. At the structural abstraction level, students are able to solve and use the right formula. However, at the second level, students do not write correctly, so the final results obtained are not correct. At the structural awareness level, students are able to provide or explain again the steps used in solving problems that have been done before.

Based on the research results obtained, the following suggestions can be conveyed by the researcher. Teachers should guide students by providing problem exercises that can increase reflective abstraction, especially considering student responses and learning outcomes collected from high and low-ability students. Therefore, further research is needed with other student data sources.

REFERENCES

Bachtiar, F. N., & Susanah, S. (2021). Abstraksi Reflektif Siswa Berkemampuan Matematika Tingkat Tinggi Dalam Pemecahan Masalah Lingkaran. *MATHEdunesa*, *10*(2), 266–278. https://doi.org/10.26740/mathedunesa.v10n2.p266-278

Ekawati, & Saragih, M. J. (2018). Kesulitan Belajar Matematika Berkaitan dengan Konsep pada Topik Aljabar: Studi Kasus pada Siswa Kelas VII Sekolah ABC Lampung. *A Journal of Language, Literature, Culture, and Education POLYGLOT*, *14*(1), 53–64.

Fajriyah, N., & Susanah. (2018). Profil Kemampuan Abstraksi Reflektif Siswa Dalam Menyelesaikan Masalah Geometri Ditinjau Dari Gaya Belajar. *Jurnal Ilmiah Pendidikan Matematika*, *7*(3), 21–29. https://jurnalmahasiswa.unesa.ac.id/index.php/mathedunesa/article/view/25554/23429

Hariastuti R. (2017). *Permainan Tebak-Tebak Buah Manggis: Sebuah Inovasi Pembelajaran Matematika Berbasis Etnomatematika (the Mangosteene Guess Game: a Mathematics Learning Inovation Based on Ethnomathematics)*. *2*(1), 25–35.

Herawaty, D., Widada, W., Nugroho, K. U. Z., & Anggoro, A. F. D. (2019). *The Improvement*

of the Understanding of Mathematical Concepts through the Implementation of Realistic Mathematics Learning and Ethnomathematics. *295*(ICETeP 2018), 21–25. https://doi.org/10.2991/icetep-18.2019.6

Kërënxhi, S., & Gjoci, P. (2017). Involvement of Algebraic-Geometrical Duality in Shaping Fraction's Meaning and Calculation Strategies with Fractions. *Journal of Educational and Social Research*, *7*(1), 151–157. https://doi.org/10.5901/jesr.2017.v7n1p151

Mawaddah, S., & Anisah, H. (2015). Kemampuan Pemecahan Masalah Matematis Siswa Pada Pembelajaran Matematika dengan Menggunakan Model Pembelajaran Generatif (Generative Learning) di SMP. *EDU-MAT: Jurnal Pendidikan Matematika*, *3*(2), 166–175. https://doi.org/10.20527/edumat.v3i2.644

Putra, E. D., Sullystiawati, L. H., & Sari, Y. I. (2023). Pendampingan Inovasi Pembelajaran Matematika SMP Melalui Permainan Ular Tangga Berbasis Etnomatematika. *Dedication*, 119–128.

Putri, R. irjayanti, & Santosa, R. heri. (2015). Keefektifan strategi REACT ditinjau dari prestasi belajar, kemampuan penyelesaian masalah, koneksi matematis, self-efficacy. *Jurnal Riset Pendidikan Matematika*, *2*(2), 262–272. https://doi.org/10.21831/jrpm.v2i2.7345

Rahmatul, R. (2017). *Motivasi dan Hasil Belajar Matematika Berbasis Etnomatematika (Budaya Matematika) dengan Permainan Tradisional Congklak Pada siswa Kelas VII MTSN 12 Tanah Datar*.

Rossydha, F., Nusantara, T., & Sukoriyanto, S. (2021). Commognitive Siswa dalam Menyelesaikan Masalah Persamaan Linier Satu Variabel. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(1), 1. https://doi.org/10.17977/jptpp.v6i1.14367

Sriwahyuni, K., & Maryati, I. (2022). Kemampuan Pemecahan Masalah Matematis Siswa Pada Materi Program Linear. *Inomatika*, *4*(1), 19–30. https://doi.org/10.35438/inomatika.v4i1.279

Sutrisna, N. (2021). *Kemampuan abstraksi reflektif matematis siswa pada materi bangun ruang*. *2*(1), 26–32. https://doi.org/10.34007/jdm.v2i1.598

Ulia, N., Waluya, S. B., Hidayah, I., & Pudjiastuti, E. (2018). *Abstraksi Reflektif Matematis Mahasiswa PGSD*.

Wiryanto. (2014). *Level-Level Abstraksi Dalam Pemecahan Masalah Matematika Abstrak*. 569–578.