Cooperative learning based on probabilistic thinking profile
SMP Muhammadiyah 3 Mlati regency of Sleman

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Abstract. The probabilistic thinking includes high order thinking skills (HOTS), which need to be trained to students through learning models. The probabilistic thinking Level of the students varies. So the purpose of the research is: (1) Want to know the high level of probabilistic thinking students SMP Muhammadiyah 3 Mlati Kabupaten Sleman, before and after following the model Prmbelajaran; (2) Want to know the effectiveness of cooperative learning model with peer tutor on heterogeneous group in raising the level of Probabilitik students of SMP Muhammadiyah 3 Mlati Kabupaten Sleman. The design of this research is research with the method of combination model or design concurrent triangulation. The method of blending qualitative and quantitative analyses. The subject in this study was a grade IX students A and B of the odd semester of SMP Muhammadiyah 3 Mlati Kabupaten Sleman. Class IX A applies cooperative learning of NHT type and KLS IX B Implementing Cooperative learning of TGT type. With heterogeneous groups and peer tutors. The results of the study and its discussion gained interesting findings in this study, which is an effective learning Model to increase the level of probability thinking of SMP Muhammadyah 3 Mlati Sleman in solving probabilistic problems, is a learning model that blends three components (1) Cooperative Learning, (2) Heterorogative groups, and (3) peer tutors. This study was named the Learning model "Koophetebaya".

1. Introduction
Research related to the probabilistic thinking is beginning in the 1990s, continuing in the era from 2000 to 2010, this period is referred to as the Contemporary Research period, while the next period after the year 2010 which is running is a period of (The Assimilation Period) [1]. Research on the theme of probabilistic thinking in the early period include research conducted by Jones and Polaki both studies have found that there are four logo in probabilistic thinking students, namely: Level 1: Subjective, Level 2: Transitional, Level 3: Informal Quantitative, and Level 4: Numerical [2-5]. Meanwhile, in the second period of the study conducted by Sujadi in his research he developed the evade offered by Jones, by adding a level of probabilistic thinking for JUNIOR High school students [6]. That has not been given probability material, he concluded that junior high school students have not received learning about the probability of having five criminals in probabilistic thinking. Concrete and computer-animated manipulation can help students improve the scheme of students at level-0 “pre-subjective probabilistic thinking” related to understanding possible outcomes, as well as reducing the influence of the aspects Irrelevant, although ultimately students have not been able to register sample room members from one-level experiments. The probabilistic thinking includes a high-level thought/Higher order Thinking Skill (HOTS), it can be seen from the group of Jean Piaget in the underlying hashing of one’s cognition development, that the logic and probability positioned at the Formal operation [7].
Sharma in his study in India concluded that in resolving the probabilistic problems many students use strategy based on beliefs, previous experience (daily and school) and intuitive strategies, from their analysis Identify the four categories of rubric that can be considered to illustrate how students build meaning to question probabilities [8]. Students have challenges in time while solving a problem [9]. While students demonstrate competence with theoretical interpretation, they are less competent on tasks involving probability definitions, this is due to them ignoring the learning standpoint of linguistic problems. The other side of probability should be understood as a kind of cultural knowledge created by all cultures, but may not look the same from one cultural setting to another culture. With many ethnic groups in major classes around the world with frame of probability programs, it is important to actually listen to the voice of students to understand what or what may not be appropriate for these students in terms of their probabilistic thinking. It is hoped that the findings reported in the laboratory will result in more interest in the study in relation to the cultural ideas that students have and the cultural differences that may impact students’ learning. Teachers, curriculum developers and researchers need to work together to find a better way to help all students in developing their probabilistic thinking [10].

Maftuh in his research wrote that the probabilistic reasoning of male students in the resolution of problems associated with the opportunity of an incident tends to respond to various situations in a context that contains elements [11]. Uncertainty, as for its reasoning in each step of solving the probability of quick subject matter in making decisions about the strategy to be used in resolving in resolving the problems given. The development of research related to the next probabilistic thinking is about the probabilistic model. Related to Nic [12], lifting understanding of the model, the meaning of the word model is seen from two sides, first is the "mathematical model, as a decision-making tool ". This meaning is known since many years; The second side is "How to think or represent an idea ". Or the like, and simply Nic describes "In a simple, concrete incarnation, a model is a representation of another object", so the model is a representation about other objects. Also, the term "model " is used to describe the way people understand their world. Whereas Lakoma [13] states that the competence of mathematical modeling of real phenomena, is a necessity for all components of mathematical literacy, and is indispensable in public education either at this time, or at the time that will be Come.

Based on the observation on 24-25 September 2018 at SMP Muhammadiyah 3 Mlati School When the mathematics lesson only explain and give the training about the process of learning teaching Math looks just monotonous. In addition, class VIII students tend to be passive in class and less interacting with the teacher, the active and self-reliance of students in the classroom learning is still lacking. Some students still feel the math is a difficult lesson, but according to the teacher, that the students can not use the way of thinking probabilistic in solving a problem in mathematics lessons. So there needs to be an effort to improve their ability to master the subject of mathematics and their thinking skills, since they will face more abstract material or mathematics.

All kinds of thinking including thinking probabilities are very related to the efforts of someone in finding solutions or solving the problems they face, the results of completion that each person will vary, both in terms of quality, Accuracy or speed. The difference in results is likely to be related to the level and model of the probability thinking that each individual has, and very likely the model thinks the probability of a student will influence the outcome of the problem solving He faced.
On the basis of such descriptions, the authors are interested in conducting research related to a probabilistic thinking profile based on cooperative learning to develop the ability of learners in problem solving. This is because with the profile of the probabilistic thinking the learners can be known to position the ability of learners at the level of their probabilistic thinking. So that learners can position themselves according to their ability in the mentoring process. Interactions are expected in heterogeneous groups that can develop student problem-solving skills. Furthermore, it is hoped that this research can find a model of mentoring that corresponds to the probabilistic thinking level of learners in problem solving, which will raise their probabilistic thinking levels to the levels above it.

2. Methods
2.1. Type and design research.
In this research researchers conducted measurements of the ability of learners related to resolution of probability problems namely: sample space, incidence, and probability of an incident. From the data analysis obtained will produce the initial portrait of the Probabilistic thought process of the research subject, grouped by the Pevelan. Next conducted an interview with a fulfilling research subject to uncover the thought process of Probabilitik. The next step is to do the mentoring with the model of good peer tutor in the classes of teaching using the NHT-type cooperative learning, as well as classes that are teaching using TGT type Cooperative learning. Next Comparing the results of both classes. The result of the application of the model of mentoring on the basis of a probabilistic thinking of learners, will be seen and analyzed the level of effectiveness. Based on these stages, the design of this research is research with the method of combination model or design concurrent triangulation. Sugiyono stated that "The design of concurrent Triangulationa is a research method that combines qualitative and quantitative research methods by mixing both methods in a balanced (50% quantitative method and 50% qualitative method) [14]. The method is used together, at the same time, but independent to answer the formulation of a similar problem ". In relation to the qualitative research of Moleong [15] states that qualitative research seeks to find theories, substantive or formal theories, all of which are clearly derived from data.

2.2. Subject research and Data collection techniques.
The subject in this study was a grade IX students A and B of the semester of Gasal SMP Muhammadiyah 3 Mlati Kabupaten Sleman. Class IX A applies cooperative learning of NHT type and KLS IX B Implementing Cooperative learning of TGT type. The establishment of small groups of 4-6 students in both classes comprises heterogeneous groups, the students who Derived from the level of different probabilistic thinking, which is designated as a tutor on the heterogeneous group, is a student who comes from students who have the highest level of probabilistic thinking. While the techniques that researchers use to collect data use: Pretes, tests, interviews, observations.

3. Result and Discussion
3.1. Numbered Heads Together Class (class IX A)
Based on the interviews of several subjects representing each of the probabilistic thinking levels obtained information that they experienced increased learning after a cooperative learning type Numbered Heads Together (NHT) with Heterogeneous group of peer tutors. They stated that the existence of cooperative learning made their learning excited, but they were so easy to communicate with other friends to discuss each other. They experienced an increase and change in the probabilistic thinking levels, from what was previously at a low level increased to a higher level. As already explained earlier that according to Jones et.all. there are four levels or levels of probabilistic thinking. Level 1 (Subjective), Level 2 (Transitional), Level 3 (Informal Quantitative), and Level 4 (Numeric). With the cooperative learning of NHT type with heterogeneous groups can facilitate students to master and study the material covered in a lesson. The heterogeneous group consists of subjects that are at different levels, so there is a subject that serves as a tutor in the group [16]. The tutor is tasked to explain and explain the material to the members of the group, the existence of peer tutors makes heterogeneous groups appear active and more passionate about learning.
From the results of interviews with several subjects representing each level of probabilistic thinking obtained the following information.
**Subject Level 1**

At level 1 selected 2 students representing S 1.1 and S 1.2. Based on the results of the pretests that has been done, in their age they have not understood and have not mastered the material, they feel kebinggungan and distress to work on the pretests. So they in response to the pretests do not use strategy and only based on his reasoning. Here are the pretests answer sheets and post test students Level 1:

![Figure 1. Pretest S1.1](image)

In the see from the results of the above Level 1 post test, indicating that they are experiencing an increase in learning. It is evident that the value of their post test is very good and increasing, they experience the change/improvement of probabilistic thinking levels to level 4.

**Subject Level 2**

At level 2 selected 2 students representing S 2.1 and S 2.2. Based on the results of pretests that have been done, in their age they understand a little problem and they are still hesitant in answering the question. So they in response to the pretests do not use strategy and only based on his reasoning. Here are the pretests answer sheets of Level 2 students:

![Figure 2. Post test S1.2](image)

In view from the results of the subject Level 2 post test above, indicating that they are experiencing an increase in learning. It is evident that the value of their post test is very good and increasing, they experience the change/improvement of probabilistic thinking levels to level 4.

**Subject Level 3**

At level 3 selected 2 students representing S 3.1 and S 3.2. Based on the results of pretests that has been done, in their age they are already familiar with the problem and have done well. But in answering the question they are still doubtful and experiencing kebinggungan. So they in response to the pretests do not use strategy and only based on his reasoning. Here are the pretests answer sheets of level 3
In view of the results of the post Level 3 subject test above, indicating that they are experiencing an increase in learning. It is evident that the value of their post test is very good and increasing, they experience the change/improvement of probabilistic thinking levels to level 4. **Subject Level 4**

At level 4 This was selected 2 students representing S 4.1 and S 4.2. Based on the results of pretests that has been done, in their age they are already familiar with the problem and have done well. So they respond to the pretests using certain strategies and patterns. Here are the pretests answer sheets of level 4 students:

![Figure 3. Pretest S4.1](image)

In view of the results of the post level 4 subjects above, indicating that they are experiencing an increase in learning. It is evident that the value of their post test is very good, and they are able to maintain the position of the highest level in probabilistic thinking, which is level 4.

3.2. Team Games Tournament Class (class IX B)

Based on the interviews of several subjects representing each of the probabilistic thinking levels obtained information that they experienced increased learning after being held cooperative learning type Team Games Tournament (TGT) with Heterogeneous groups. They stated that the existence of cooperative learning made their learning excited, but they were so easy to communicate with other friends to discuss each other. They experienced an increase and change in the probabilistic thinking levels, from what was previously at a low level increased to a higher level. As already explained earlier that according to Jones DKK there are four levels or levels of probabilistic thinking, Level 1 (Subjective), Level 2 (Transitional), Level 3 (Informal quantitative), and Level 4 (Numeric). With the TGT-type cooperative learning with heterogeneous groups, it is easy for students to master and study the material included in the lesson. The heterogeneous group consists of subjects that are at different levels, so there is a subject that is used as a peer tutor in the group. The peer tutor is tasked to explain and explain the material to members of the group, the existence of peer tutors makes heterogeneous groups look active and more passionate about learning.

From the results of interviews with several subjects representing each level of probabilistic thinking obtained the following information.
Subject Level 1
At level 1 selected 2 students representing. Based on the results of Pretest that has been done, in their age they do not know the opportunity and have not mastered Materipeluang, they feel kebingungan and distress to work on the Pretest. So they in response to the Pretest do not use a strategy and only filled as many of them even answered the origin. Here's the answer sheet Pretest student Level 1:

![Figure 5. Pretest Level 1 (S1.1) and (S1.2)](image)

In view of the results Post Test the subject level 1 above, indicating that they are experiencing an increase in learning. It is evident that the value of Post Test them is good and increases, they experience the change/improvement levels of probabilistic Thinking to Level 3 and Level 4.

Subject Level 2
At level 2 selected 2 students representing. Based on the results Pretest has been done, in the end they can already register 1 complete set of experimental results 1 level, but have not been able to register experiments 2 levels using a good strategy. The Pretest answer sheet of Level 2 students can be seen in Figure 6.

![Figure 6. Pretest Level 2(S2.1)](image)

In See from the results of Post Test subject level 2 above, indicating that they are experiencing an increase in learning. It is evident that their Post Test scores were increased compared to their Pretest scores but at level 2 S 2.1 experienced a level increase from Level 2 (Transitional) to Level 3 (Informal quantitative) while S 2.2 did not increase levels Level 2 (Transitional) and only increase the value.

Subject Level 3
At level 3 selected 2 students representing. Based on the results of Pretest that has been done, in their age they can already register the results of the experiment 2 stages and already has the ability to
align and quantify the thinking about the sample space, only that they cannot register fully. Here's the answer sheet Pretest students Level 3:

![Figure 7. Post Test Level 3 (S3.2)](image)

In See from the results of Post Test the subject level 3 above, indicating that they are experiencing an increase in learning. It is evident that the value of their Post Test is good and increases, but at S 3.1 did not increase the level and remained in Level 3 (Informal quantitative) just increased the Post Test value, Beda with S 3.2 that increased levels from Level 3 (Informal quantitative) becomes Level 4 (Numeric).

**Subject Level 4**

At level 4 selected 2 students representing. Based on the results of Pretest that has been done, in the end they have been able to register the results of the experiment 2 stages fully and has been able to mention the opportunity of the incidence of a numeric. Here's the answer sheet Pretest students level 4:

In view of the Post Test results The subject level 4 above, indicating that they are experiencing an increase in learning. It is proven that S 4.1 do not experience a drop in levels and remain in Level 4 (Numeric) while the S 4.2 instead decreased from Level 4 (Numeric) to Level 3 (Informal quantitative) caused by lack of focus on the problem Post Test.

![Figure 8. Pretest Level 4(S4.1) and (S4.2)](image)
**Analisys and Discussion of quantitative data**

### Table 1. ANAVA for Eksperiment Factorial Design (4 x 2)

| Source Variances | df | SQ    | MSQ (QC) | F    |
|------------------|----|-------|----------|------|
| Mean             | 1  | 215.204 | 215.204  | 0.9244 |
| Treatment        |    |        |          |       |
| A                | 3  | 567,6215 | 189,2072 |       |
| B                | 1  | 698,2749 | 698,2749 | 3.4114 |
| AB               | 3  | 1,042,0861 | 347,3621 | 1.6970 |
| Galat            | 35 | 7.164,0175 | 204,6862 |       |
| Sum              | 43 | 224,676 |          |       |

Hypothesis testing results for $\alpha = 10\%$ obtained $F_{0.10}(3.35) = 2.23 > F_{count} = 0.9244$, so that $H_{0.1}$ was received, and $H_{1.1}$ was rejected, which means the probabilistic thinking factor students do not give effect or influence on the ability to resolve problems Probabilistic, at a level of significance 10%. $F_{0.10}(1.35) = 2.84 < F_{count} = 3.4114$, so $H_{1.2}$ is accepted, and $H_{0.2}$ is rejected, which means the use of cooperative learning models provides effect or influence on the students’ ability to solve probabilistic problems, on the level of Significance 10%. $F_{0.10}(3.35) = 2.23 > F_{count} = 1.6970$, so $H_{0.3}$ was received, and $H_{1.3}$ was rejected, which meant the interaction of the probabilistic thinking factor and the use of cooperative learning models, did not give effect or influence on the ability of students in Solve the probabilistic problems, in the level of significance 10%.

The hypothesis test results showed that the use of cooperative learning models gives effect or influence on students’ ability to solve probabilistic problems, at a level of significance of 10%. So qualitative data analysis results in favor of qualitative data analysis results, that cooperative learning affects students’ ability to solve probability problems. Average post test class score IX A of 74.68, greater than the average post test result of class IX B of 66.62; As an indicator that the cooperative learning of NHT type is more effective than the cooperative learning of TGT type.

**4. Conclusion**

The results of the study and its discussion resulted in an interesting finding in this study, which is an effective learning Model to increase the probability of thinking of junior High students Muhammadiyah 3 Mlati Sleman District in solving the problem Probability, is a learning model that combines three components: (1) Cooperative Learning, (2) heterogeneous groups, and (3) peer tutors. Call it the learning model "Koophetebaya".

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