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Learning Probability using the Context of Dragon Traditional Game

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Abstract. Probability is one of the essential mathematical topics to learn because it has many applications in daily life. However, students still have difficulty in probability learning, such as a lack of understanding of students' concepts. Therefore, it is necessary to design learning with the proper context and approach to facilitate student understanding. This study aims to produce a learning trajectory of Probability using dragon traditional games based on Indonesia Realistic Mathematics Education. The method used is design research. There are three stages: preparation stage, experiment design (pilot and teaching experiments), and retrospective analysis. The subjects involved were 8th Class students of MTs Miftahul Ulum Margasari. The resulting learning trajectory consists of a series of learning processes of 4 student learning activities, namely: 1) observing the context video to identify the number of events and experiments, and determine the empirical probability formula, 2) determining the theoretical probability formula, 3) determining the sample space, sample point, and the expected frequency formula, 4) solving contextual problems related to probability. The article only describes the research results of the pilot experiment to find out the actual resulting trajectory that is ready to be tested into the teaching experiment stage. This research can inspire to explore other local wisdom as a context to introduce mathematical concepts, improve understanding, and create meaningful learning.

INTRODUCTION

Mathematics is one of the subjects that must be learned at the education level. Mathematics subjects facilitate students to have the ability to think logically, analytically, systematically, critically, creatively, and the ability to cooperate (Kemendikbud, 2017). One of the mathematical topics studied at school, especially the junior high school level [1] is Probability. Probability is one of the essential mathematical materials to learn because of the many applications in daily life, such as predicting an event. Although the probability material is essential to learn, students still consider this material difficult [2].

The difficulties experienced by students when learning probability are in the probability formula; students have difficulty in memorizing the probability formula and apply it to questions [3]. Sina stated that students have difficulty learning probability because of so many calculations, formulas that need to be memorized, and the difficulty of imagining a theory in daily life [4]. Another study said that students' difficulties in understanding the probability material such as difficulty in determining the empirical probability of an experiment and the sample space. This is because students do not understand the concept of the material [5]. Tjiptiany et al. [6] added that students' difficulties in learning are caused by students being less motivated by monotonous learning. Prasetya [7] also said that the learning process in Indonesia is still predominantly teacher-centered, i.e., students are passive in the learning process and students only receive knowledge or material presented by the teacher. In addition, teachers who are less innovative make learning monotonous. Most teachers in teaching mathematics only provide explanations, provide practice

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questions, examine practice questions, and give assignments. Students are not given the opportunity to be actively involved in learning such as expressing opinions or discussing differences in answers between students [8].

In this case, to overcome the difficulties of learning probability, create learning that involves students actively, and provides opportunities for the students to learn by increasing their knowledge [8], it is necessary to design learning probability using the right approach, media, and context. One suitable approach is IRME (Indonesian Realistic Mathematics Education) [9].

IRME is one of the learning approaches that refers to Freudenthal's opinion that mathematics is a human activity closely related to daily life [10] to make easier for the students to imagine mathematics and make learning more interactive [11]. IRME has been used in learning since 2001 to be able to improve the ability to solve problems and motivate students [12][13][14] and facilitate students to think critically and creatively so that it is easy to understand concepts [15] [16]. Yusmanita et al. [17] added that IRME is a learning approach that facilitates students to construct concepts by implementing them in daily life. This is supported by Nursyahidah et al. [18], who say that learning with IRME starts from a context to connect informal mathematics into formal mathematics. PMRI-based learning start from the context as starting point in learning. The context in mathematics is used to know that mathematics is very close to real life [11]. The context can use the cultural context and can be modified according to the local context where the school is located. This can provide interesting contextual knowledge in schools because it can improve students' problem solving abilities related to everyday life. The context used is very familiar to students in their daily life which is expected to grow and develop cultural values that can affect the character of students [16]. The learning context used in this study is the context of the dragon traditional game.

The selection of the dragon traditional game is because the game can be used to introduce probability material for students and can be a source of learning and starting point in learning probability. In addition, this traditional context invites students to preserve local wisdom, make learning activities more meaningful, and motivate students to learn mathematics.

Based on the background described above, the authors researched by producing student learning trajectory in understanding the probability material in the context of the Dragon traditional game, increasing students' learning motivation, and creating meaningful learning.

RESEARCH METHODS

The method used in this study is the design research method with 3 main stages aimed at developing theories and improving the learning process [21]. The three stages of design research [22] are (1) preparation stage, (2) design experiment, (pilot experiment and teaching experiment), and (3) retrospective analysis. However, this study only discusses the results of the pilot experiment to provide a detailed description of the results of the pilot experiment stage, which then are tested again in teaching experiments.

The subjects involved in the pilot experiment were six 8th grade students from MTs Miftahul Ulum Margasari. The six students involved consisted of three different abilities, namely high, medium and low abilities, based on teacher recommendations and the latest learning outcomes. In this study, a probability learning trajectory consists of a series of learning processes in the form of conjectures that can be modified and developed in teaching experiments. Data was collected through the results of student work and the recording of learning activities. All data obtained were analyzed by comparing HLT and actual learning.

RESULTS AND DISCUSSION

The result of this study is the learning trajectory of the probability material using one of the traditional games, Dragon, as a context that is adapted to the Indonesia Realistic Mathematics Education approach. The resulting learning trajectory is a series of learning processes consisting of 4 activities, namely: 1) observing the context of the video to identify the number of events and experiments and determine the empirical probability formula, 2) determining the theoretical probability formula, 3) determining the sample space, sample point, and the expected frequency formula, 4) solving contextual problems related to probability. Based on the activities that have been designed, students show a good response and understanding of the material through the context used, which can be seen in the results of student work and student activity records. Before doing the activity, the researchers gave a pretest to the students to find out the students' initial abilities before getting the lesson. And at the end of the activity, the researcher also gave a posttest

to find out the differences in students' abilities at the beginning and the end of the lesson. The following is an explanation of the activities and results of student work:

Observing the Video Context to Identify the Number of Events and Experiments and Determine the Empirical Probability Formula

Before the students were asked to do the activity sheet, the researchers gave an apperception with an interactive video of the dragon traditional game to help students to complete the activity sheet well. The researcher gave activity 1, which contains several questions to determine the probability of occurrence. Fig. 1 shows a picture of students watching a video of the Dragon traditional games. Then, students were asked to form groups consisting of 2 students in each group.

FIGURE 1. Students were observing the context video

The activity begins with students being asked to observe the context video then determine the name, the number of kids playing, and how to play the game from the displayed context video. Moreover, students are given the following problem.

"There are 2 people who are the "gates," namely Andi and Ari, and 6 people who become the dragon. The 6 students are A, B, C, D, E, and F. In the first round, who was caught was B, and he chose Ari's line. Then he continued for the 2nd round that was caught, namely C, and he chose Andi's line. He continued for the 3rd round that was caught E, and he chose Ari's line. Then round 4 who were caught were D, and he chose Andi's line. Followed by the 5th round who was caught, namely A, and he chose Andi. Then for the 6th round who was caught F, he chose Andi. And in the 7th round who was caught C, and he chose Ari. And for the last round caught E, and he chose Andi."

Students were asked to list events and experiments from the game illustrated in the problem above from these problems. Using the context of Dragon traditional games, students can determine the number of players on the dragon, which is expressed as many experiments, determine the empirical probability formula, and calculate the empirical Probability in the given context. Students are active in discussing and asking questions to complete activity 1. After students complete the activity, students are asked to one group present the result of their discussion. And the researchers ask other students if they have different results. Fig. 2 students' answers on activity 1.

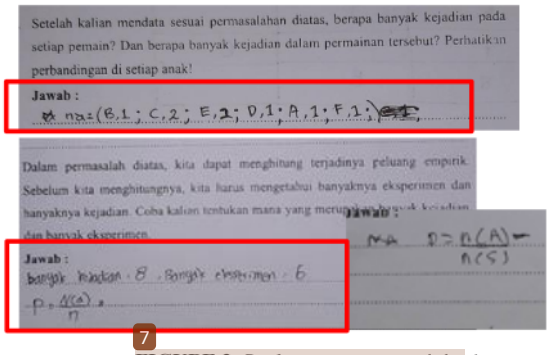

FIGURE 2. Student answer on activity 1

Based on Fig. 2, students carefully understand the existing problems. So that students can determine the number of events and experiments correctly. In addition, based on the problems and activities given, students can correctly determine the empirical probability formula. In this activity, the teacher provides a stimulus to students to construct their knowledge about empirical probabilities.

Determining the Theoretical Probability Formula

Students were given an activity sheet in group discussions with members who were still the same in the previous activity in the second activity. Students were asked to determine theoretical probabilities. Students are directed to answer questions that include determining many events, presenting data on existing problems, finding formulas for theoretical probabilities, and determining theoretical probabilities in the given context to determine academic opportunities. The problems given are as follows:

"After you count the number of participants who take part in the dragon traditional game. There are 2 people as the "gate". If everyone has 1 chance to get caught. How many "caught" events in the game above? If there is an event that the 2nd person is caught 2 times, the 4th person is caught 2 times, the 6th person is caught 2 times, and the others are caught 1 time. Try your data according to the statement above!"

From the problem above, students are directed to understand theoretical Probability and find the formula. The following Fig. is the student answer on activity 2.

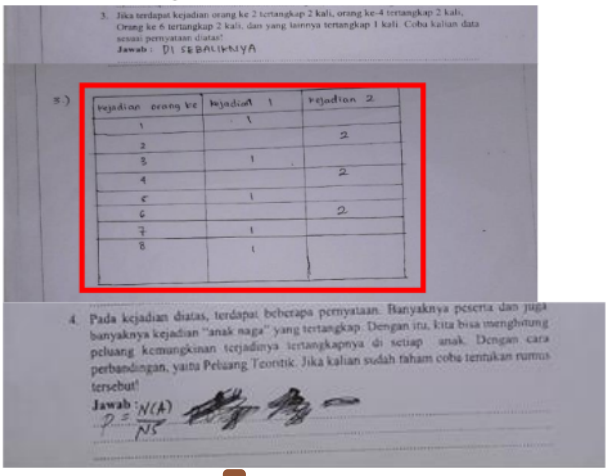

FIGURE 3. Student answer on activity 2

Based on the picture above, it can be seen that students are able to present the data well in accordance with the existing statements. With students present data correctly, students will find it easier to determine theoretical probabilities. Based on interviews with teachers, students are also able to explain what has been written on the activity sheet and understand theoretical probabilities well. Students also can write down the theoretical probabilities correctly.

Determining the Sample Space, Sample Point, and the Expected Frequency Formula

In activity 3, students were given an activity sheet to discuss with their groups. Students were asked to determine the sample space and sample points. The activity sheet has given a little direction and stimulus regarding what a sample space is and a sample point. After that, students were asked to examine the stimulus on the activity sheet and determine the sample space and sample points in the given context problem, such as writing down the sample space and sample point of participants in the Dragon traditional game. The activity sheet also presents additional problems to check students' understanding of the sample space and sample points. Fig. 4 shows the results of students' answers in understanding sample space and sample point.

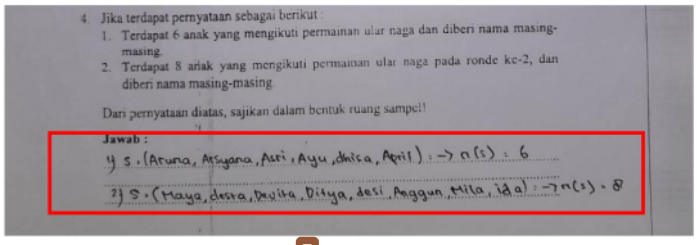

FIGURE 4. Student answer on activity 3

Based on the picture above, it can be seen that students were able to determine the sample space well. And based on interviews with the teacher, students were able to explain the sample space and correctly mention the sample points. In addition, students can carry out the designed activities so that the student's answer is correct.

The activity is continued with students determine the frequency of expectations in the given context. Before students determine the frequency of expectations, students are directed to determine the sample space and sample points on the existing problems. After that, students are given some stimulus on the activity sheet to understand the frequency of expectations and write the formula. Fig. 5 shows that students can write the formula for the frequency of expectations correctly and adequately by following every activity designed by the teacher.

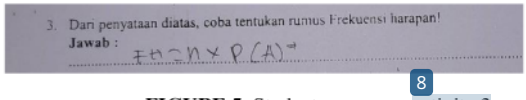

FIGURE 5. Student answer on activity 3

Solving Contextual Problems Related to Probability

In the last activity, students were asked to solve a contextual problem about probability. In solving problems, students discuss in groups the activities that have been done before. In the activity, students solve the problems given based on the knowledge gained in the previous activity. Fig. 6 below is the result of student work in activity 4.

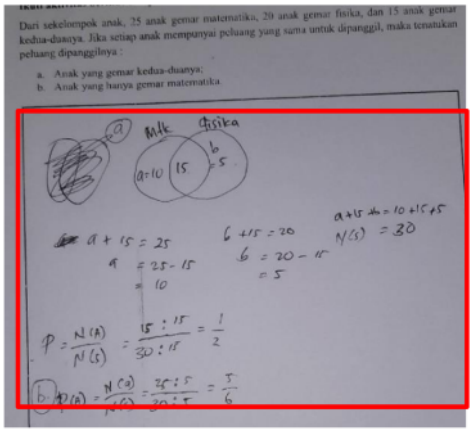

FIGURE 6. Student answer on activity 4

Fig. 6 shows that students have a strategy for working on problems, namely using a Venn diagram to represent the problem. From the Venn diagram, students were able to determine the number of students who like math, the number of students who like physics, and the number of students who like both correctly. At point (a) to determine which children like both, they can apply the existing problems into the probability formula and produce the correct student answers. However, in point (b) there is an error when entering the number of events or the number of students who like mathematics. It should be that the value entered is 10 and produces an answer: $P(A) = \frac{10}{30} = \frac{1}{3}$. With the teacher's guidance, students know their mistakes in doing the problem given and can correct the mistakes well.

Based on the results described above, all activities are designed according to the characteristics of IRME [19], including (a) the use of context: the context used in this study is the Dragon traditional game which is a source of learning and starting point; (b) the use of models and symbols for progressive mathematics: the use of models in learning can bridge informal information from context to formal information. (c) student contributions: in learning, students can be actively involved in completing the given activities. Students can ask questions, discuss, and express opinions during learning, (d) interactivity: interactivity in learning can be formed from interactions between teachers and students, students and students, and students with learning instruments; (e) the intertwining which ensures more meaningful mathematics because it can be applied to other learning topics. Based on the results of student work on activity sheets and learning recordings, traditional game contexts can introduce mathematical topics and make it easier for students to understand the concept of probability starting from context to formal understanding and able to facilitate students to be actively involved in learning to solve the problems given. This is in line with Nursyahidah et al. [13] stated that using the right context can encourage the development of students' mathematical thinking from informal information from context to formal mathematics. Hasibuan [20] also revealed that teaching materials based on a valid and effective realistic mathematics education approach can improve problem solving skills and student learning independence.

CONCLUSION

The learning trajectory produced in this study consists of 4 activities, namely: 1) observing the context of the video, to identify the number of events and experiments, and determine the empirical probability formula, 2) determining the theoretical probability formula, 3) determining the sample space, sample point, and the expected frequency formula, 4) solving contextual problems related to Probability. This study shows that learning probability with the context of traditional games can facilitate understanding of the material through a series of student learning processes designed.

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