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The context of Prabumulih Market Snacks as a support in learning probability material

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Abstract

This research aims to produce learning activities that can help students understand the concept of probability material using the PMRI approach through Prabumulih City market snacks. This research was conducted at SMAN 6 Prabumulih, class 12. The research method used was design research with validation research type (preparation stage and pilot experiment). The instruments used in this research were observation, documentation, interviews and tests. This research produces student learning estimates (HLT) in the form of student learning trajectories in probability material. The researcher tested the sequence of activities and conjectures of students' thinking that had been designed at the preparation stage on 8 students and compared the results obtained. This testing was carried out at the design experiment stage, namely a pilot experiment to produce learning trajectories in the form of appropriate learning activities on probability material, the subject of enumeration rules. The results of data analysis conclude that the resulting learning activities can be seen as an alternative method for teachers to help students learn the concept of opportunity. The context of market snacks that researchers use are relevant to probability material and improve the reasoning ability of students

Keywords*: Probability, PMRI, Prabumulih City snack market, design research .*

Abstrak

Penelitian ini bertujuan untuk menghasilkan aktivitas-aktivitas pembelajaran yang dapat membantu peserta didik memahami konsep materi peluang dengan menggunakan pendekatan PMRI melalui jajanan pasar Kota Prabumulih. Penelitian ini dilakukan di SMAN 6 Prabumulih, kelas 12. Metode penelitian yang digunakan adalah penelitian desain dengan tipe penelitian validasi (tahap persiapan dan *pilot experiment*). Instrumen yang digunakan dalam penelitian ini adalah observasi, dokumentasi, wawancara, dan tes. Penelitian ini menghasilkan dugaan belajar peserta didik (HLT) berupa lintasan belajar peserta didik pada materi peluang. Peneliti mengujicobakan urutan aktivitas dan kojektur pemikiran peserta didik yang telah dirancang pada tahap persiapan kepada 8 orang peserta didik dan membandingkan hasil yang diperoleh. Pengujian ini dilakukan pada tahap *design experiment*, yakni *pilot experiment* untuk menghasilkan lintasan belajar berupa aktivitas-aktivitas belajar yang tepat pada materi peluang, pokok bahasan kaidah pencacahan. Hasil dari analisis data menyimpulkan bahwa aktivitas-aktivitas pembelajaran yang dihasilkan dapat dipandang sebagai metode alternatif bagi guru untuk membantu peserta didik mempelajari konsep peluang. Konteks jajanan pasar yang peneliti gunakan relevan dengan dengan pembelajaran peluang dan membantu melatih penalaran matematika peserta didik .

Kata kunci: peluang, PMRI, jajanan pasar Kota Prabumulih, penelitian desain

INTRODUCTION

Probability is one of the materials contained in the 2013 curriculum and the merdeka curriculum. In this article, researchers use the 2013 curriculum, namely based on Minister of Education and Culture Regulation Number 37 of 2018. However, the learning objectives that researchers use can be adjusted to the learning outcomes contained in the merdeka curriculum in probability material, namely phases E and F. Probability is a domain in mathematics that studies the size of the uncertainty of an event in life. According to Wijaya et al. (2021), uncertainty is a phenomenon that underlies the mathematical analysis of many problem situations. In addition, decision making involving uncertainty has become an integral part of the modern era today.

Along with that, Armiati et al. (2022), said that probability is a topic that measures uncertainty that occurs in everyday life and is part of mathematical literacy. Mathematical literacy is an individual's ability to understand, apply and use mathematical concepts in various contexts of daily life. Mathematical literacy is one of the domains contained in the PISA questions. One example of a PISA-like problem was carried out by Putri & Zulkardi (2020), designing a PISA-like mathematics task using the context of the Asian Games who designed the sharing and jumping task using the context of football and bowling. Students are asked to determine the number of matches and positions for throwing bowling. These problems require reasoning abilities to solve them.

Reasoning abilities are also needed in solving enumeration rules problems. Tanzimah & Sutrianti (2023) said that enumeration rules material is one type of probability question that appears in PISA questions. Many students do not understand the concept of enumeration rules, as a result, errors occur in the probability material. In fact, our Minister of Education and Culture, Nadiem Makarim in 2022 through detikedu said that probability is one of the areas of mathematics that students must master (Kristina, 2022). The weak ability of students to solve probability problems can be caused by the textbooks used, not giving students the probability to learn mathematical procedures in solving context-based problems, the practice questions contained in the textbooks still use easy sentences. students understand without relating it to their daily life (Fatmawati et al., 2023).

One effort that teachers can make to help students master probability material is to design learning using the PMRI (Indonesian Realistic Mathematics Education) approach. This approach is very suitable for use in mathematics learning, as stated by (Zulkardi et al., 2020) who said that PMRI is a didactical approach specifically for the mathematics domain adapted from RME. The PMRI learning process starts from real contexts or

situations that students experience or can recognize to connect informal mathematics to formal mathematics (Sari et al., 2022). There have been many contexts used in probability material, including the use of the context of throwing dice and coins (Armiati et al., 2022); use of the sudoku and snakes and ladders games (Wijaya et al., 2021), use of the dragon snake game (Sari et al., 2022), Monpera context (Meriza et al., 2023), credit price context (Rahmi et al., 2020). From these contexts it is possible to help students in learning probability material. Researchers found that the researchers designed activities that involved students' mathematical reasoning. Therefore, in this case, the researcher tried to design learning activities for probability material by involving students' reasoning abilities using other contexts.

Researchers use the context of market snacks in Prabumulih City, South Sumatra to help students understand the concept of probability. The researcher did this because other researchers have not found this use of context in probability material. Based on the description above, in this research the researcher designed learning opportunities using the context of the snack market in Prabumulih City, South Sumatra. The results of the learning design are activities that utilize the context of market snacks to help students understand the concept of probability, in this case it is hoped that students can understand the concept of sample space, sample points and enumeration rules.

Thus, the aim of this research is to help grade 12 students understand the concept of probability (sample space, sample points, and enumeration rules), as well as to help students develop their reasoning skills using the context of the snack market in Prabumulih City, South Sumatra.

METHOD

The research method that researchers use is design research, with a validation study type, which consists of three stages, namely preparing for experiment, design experiment , and retrospective analysis (Gravemeijer, K. & Cobb, 2013). In this article, researchers will only discuss the first two stages, namely preparing for experiment, and design experiment (pilot experiment).

At the preparing for experiment stage, researchers focused on preparation and design, looking for literature reviews, looking for basic competencies in probability material in the 2013 curriculum, designing instruments in the form of Student Worksheets (LKPD), observation sheets, tests and interview guides. Researchers began designing probability material for the topic of enumeration rules (addition and multiplication rules) for class 12 using the context of market snacks in Prabumulih City, South Sumatra. This

material contains learning activities which are expected to help students understand the concept of sample space, sample points and enumeration rules.

The researcher designed two activities based on the contextual problems given, namely arranging types of food in the form of market snacks in Prabumulih City. Apart from designing the material, the researcher also designed a Hypothetical Learning Trajectory (HLT), in the form of predicted answers that would be generated by students regarding the material that had been designed. The LKPD was tested at the design experiment stage (pilot experiment).

Researchers carried out pilot experiment to test the LKPD that has been designed. The subjects of this research were grade 12 science students. At this stage, the researcher tested the LKPD on a small group of students consisting of two groups. Each group consists of 4 people, each member of which has high, medium, moderate and low abilities. Each person is given a LKPD to work on individually, then discussed in their group. The researchers' considerations in determining the literature review were those related to probability material and the 2013 curriculum. This can be seen from the basic competencies in probability material contained in the 2013 curriculum for students grade 12.

The instrument used in this research was the LKPD. The data collection techniques that researchers used in this research were observation, documentation, tests and interviews. Researchers made observations and documentation in the form of photos and videos of the LKPD work process during the pilot experiment , and the results of students' answers on the answer sheet to find out the weaknesses and strengths of the LKPD produced as well as see the possibilities that occur from the initial HLT and collect the data needed to revise the HLT. The test is used to determine students' understanding of the enumeration rules material (addition and multiplication rules).

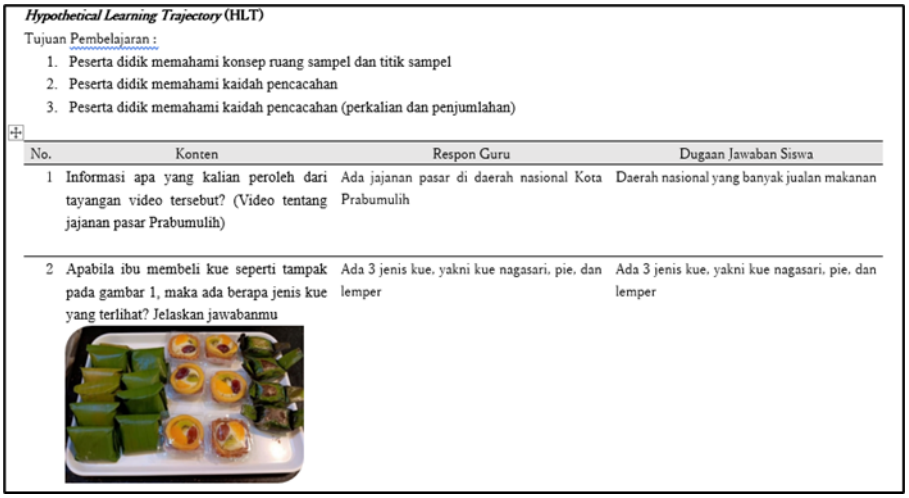
The data that researchers obtained was analyzed using qualitative descriptive methods to describe students' learning trajectories during the LKPD trial. Interviews are conducted at the end of the lesson. The aspect of the interview guide is regarding the students' feelings and the difficulties they face after working on the LKPD.

RESULT AND DISCUSSION

This research produces student learning trajectories obtained from learning activities on probability material, the subject of enumeration rules using the PMRI approach. The context that researchers used in designing the learning trajectory was the snack market in Prabumulih City, South Sumatra.

At the preparing for experiment stage, as an initial step in the research, researchers have searched for basic competencies in probability material contained in the 2013 curriculum. Obtained two basic competencies (KD) in probability material based on Permendikbud No. 37 of 2018 (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2018). Those are analyzing enumeration rules (addition rules, rules multiplication, permutation, and combination) through contextual problems and solving contextual problems related to enumeration rules. Apart from that, the researcher also conducted a literature review which produced reference material for opportunities that the researcher used in designing learning activities which were outlined in the form of a Student Learning Worksheet (LKPD).

Guided by these two KD's, and the literature study, the researcher designed a learning plan and LKPD on probability material, the subject of enumeration rules using the context of Prabumulih City market snacks. Apart from that, in this stage the researcher also produces an HLT which contains the teacher's answers and predicted student responses to the LKPD that has been designed, an example of which is as shown in **Figure 1**.



Hypothetical Learning Trajectory (HLT)

Tujuan Pembelajaran :

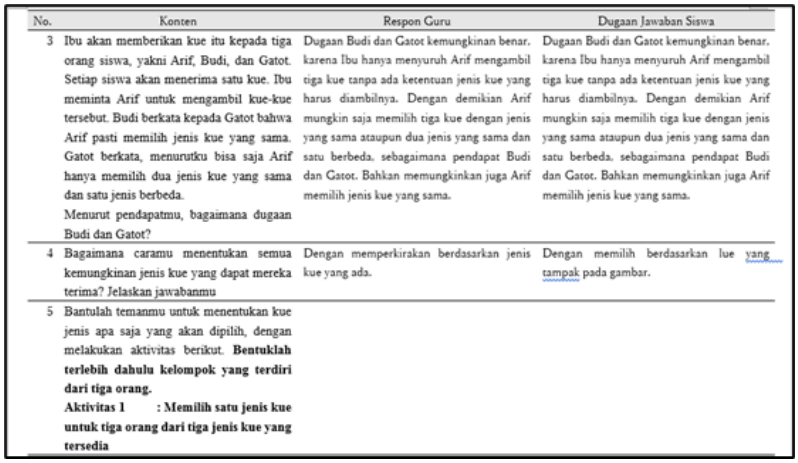
1. Peserta didik memahami konsep ruang sampel dan titik sampel
2. Peserta didik memahami kaidah pencacahan
3. Peserta didik memahami kaidah pencacahan (perkalian dan penjumlahan)

No.	Konten	Respon Guru	Dugaan Jawaban Siswa
1	Informasi apa yang kalian peroleh dari tayangan video tersebut? (Video tentang jajanan pasar Prabumulih)	Ada jajanan pasar di daerah nasional Kota Prabumulih	Daerah nasional yang banyak jualan makanan
2	Apabila ibu membeli kue seperti tampak pada gambar 1, maka ada berapa jenis kue yang terlihat? Jelaskan jawabanmu	Ada 3 jenis kue, yakni kue nagasari, pie, dan lemper	Ada 3 jenis kue, yakni kue nagasari, pie, dan lemper

Figure 1. Example of HLT

Figure 1 shows the HLT that the researchers designed. The HLT contains three components, namely content, teacher responses and suspected student answers. This content is the content contained in the LKPD, in the form of contextual problems related to market snacks in Prabumulih City. The teacher's response is the teacher's answer to the contextual problems presented in the LKPD. Predictions of student answers are the result of researchers' guesses regarding the answers that students will give to the LKPD.

Through the context of market snacks, the researcher raises a problem that requires students' reasoning abilities to solve it. Based on these problems, researchers began to design learning activities, as shown in **Figure 2** .



No.	Konten	Respon Guru	Dugaan Jawaban Siswa
3	Ibu akan memberikan kue itu kepada tiga orang siswa, yakni Arif, Budi, dan Gatot. Setiap siswa akan menerima satu kue. Ibu meminta Arif untuk mengambil kue-kue tersebut. Budi berkata kepada Gatot bahwa Arif pasti memilih jenis kue yang sama. Gatot berkata, menurutku bisa saja Arif hanya memilih dua jenis kue yang sama dan satu jenis berbeda. Menurut pendapatmu, bagaimana dugaan Budi dan Gatot?	Dugaan Budi dan Gatot kemungkinan benar. karena Ibu hanya menyuruh Arif mengambil tiga kue tanpa ada ketentuan jenis kue yang harus diambilnya. Dengan demikian Arif mungkin saja memilih tiga kue dengan jenis yang sama ataupun dua jenis yang sama dan satu berbeda. sebagaimana pendapat Budi dan Gatot. Bahkan memungkinkan juga Arif memilih jenis kue yang sama.	Dugaan Budi dan Gatot kemungkinan benar. karena Ibu hanya menyuruh Arif mengambil tiga kue tanpa ada ketentuan jenis kue yang harus diambilnya. Dengan demikian Arif mungkin saja memilih tiga kue dengan jenis yang sama ataupun dua jenis yang sama dan satu berbeda. sebagaimana pendapat Budi dan Gatot. Bahkan memungkinkan juga Arif memilih jenis kue yang sama.
4	Bagaimana caramu menentukan semua kemungkinan jenis kue yang dapat mereka terima? Jelaskan jawabanmu	Dengan memperkirakan berdasarkan jenis kue yang ada.	Dengan memilih berdasarkan lue yang tampak pada gambar.
5	Bantulah temanmu untuk menentukan kue jenis apa saja yang akan dipilih, dengan melakukan aktivitas berikut. **Bentuklah terlebih dahulu kelompok yang terdiri dari tiga orang.** **Aktivitas 1 : Memilih satu jenis kue untuk tiga orang dari tiga jenis kue yang tersedia**		

Figure 2. HLT of contextual problems related to market snacks

Figure 2 shows the HLT that researchers designed regarding contextual problems related to market snacks that have been provided. The problem started with two children's suspicions about the cake being taken by their friend. Students are asked to respond to these allegations. Then they were invited to solve the problem through activity 1, namely the activity of choosing one type of cake for three people from three types of cakes available.

Activity 1 consists of 6 questions which are expected to help students learn the rules of enumeration (multiplication rules). The questions presented are related to contextual problems, as previously described, as seen in **Figure 3**.

Aktivitas 1 : Memilih satu jenis kue untuk tiga orang dari tiga jenis kue yang tersedia

1. Ada berapa susunan jenis kue yang tampak pada Gambar 1? Jelaskan jawabanmu.

Jawab:

2. Jika masing-masing kalian akan memilih salah satu jenis kue seperti yang terdapat pada gambar 1, maka tuliskan semua kemungkinan jenis kue yang dapat dipilih ke dalam tabel 1 berikut.

Tabel 1. Semua kemungkinan kejadian memilih tiga kue dari tiga jenis kue berbeda

No.	Siswa 1	Siswa 2	Siswa 3
Banyak seluruh kejadian =			

Figure 3. Activity 1 on the LKPD

Figure 3 shows activity 1 that the researcher designed on the LKPD. Through activity 1, students are asked to write down all the possible types of cake that can be chosen for three people, if each person gets one cake. The results they obtained are presented in the table provided.

Next, students are asked to present all these possibilities in a tree diagram. Researchers use tree diagrams because according to researchers tree diagrams make it easier for students to write down all the possibilities that will occur, as seen in **Figure 4.**

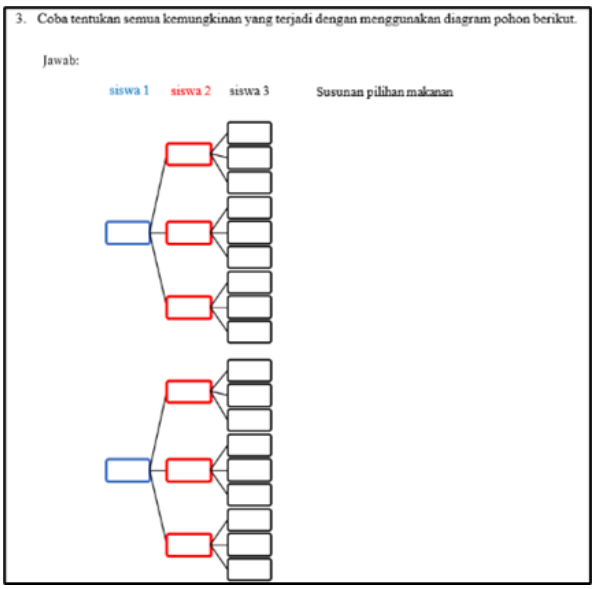
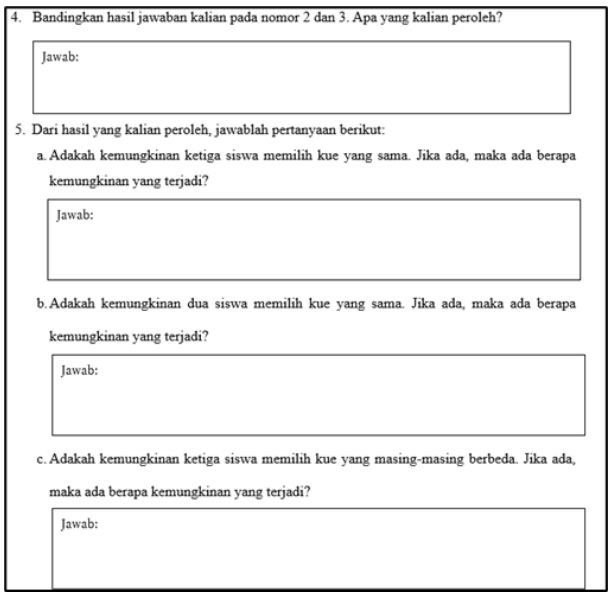


Figure 4. Presentation of tree diagram in LKPD

Figure 4 shows the tree diagram that researchers use in the LKPD. Students can determine all possible types of cake that can be selected using a tree diagram. Next, students compare the results in tables and tree diagrams. They were asked to determine more accurate results. After they found accurate results, they were invited to analyze the sample space to answer 3 trigger questions as shown in **Figure 5**.


4. Bandingkan hasil jawaban kalian pada nomor 2 dan 3. Apa yang kalian peroleh?

Jawab:

5. Dari hasil yang kalian peroleh, jawablah pertanyaan berikut:

a. Adakah kemungkinan ketiga siswa memilih kue yang sama. Jika ada, maka ada berapa kemungkinan yang terjadi?

Jawab:

b. Adakah kemungkinan dua siswa memilih kue yang sama. Jika ada, maka ada berapa kemungkinan yang terjadi?

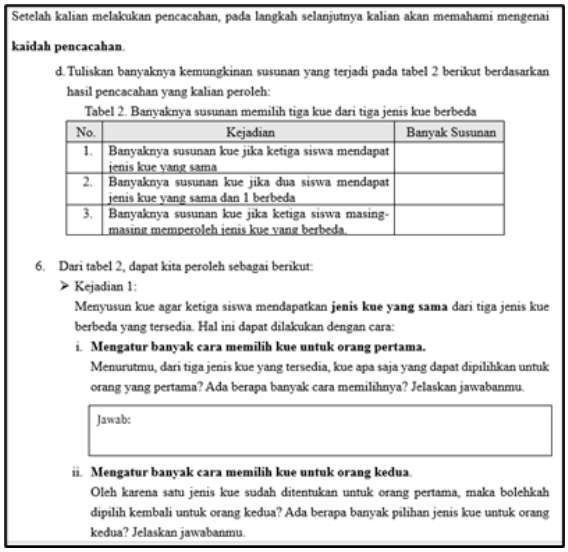
Jawab:

c. Adakah kemungkinan ketiga siswa memilih kue yang masing-masing berbeda. Jika ada, maka ada berapa kemungkinan yang terjadi?

Jawab:

Figure 5. Sparking Questions on LKPD

Figure 5 shows that there are three trigger questions after students determine the sample space of the event of choosing three cakes from the three types of cakes available. Through these brainstorming questions, students will find the number of ways each event occurs, which will then lead them to find enumeration rules, as shown in **Figure 6.**


Setelah kalian melakukan pencacahan, pada langkah selanjutnya kalian akan memahami mengenai **kaidah pencacahan**.

d. Tuliskan banyaknya kemungkinan susunan yang terjadi pada tabel 2 berikut berdasarkan hasil pencacahan yang kalian peroleh:

Tabel 2. Banyaknya susunan memilih tiga kue dari tiga jenis kue berbeda

No.	Kejadian	Banyak Susunan
1.	Banyaknya susunan kue jika ketiga siswa mendapat jenis kue yang sama	
2.	Banyaknya susunan kue jika dua siswa mendapat jenis kue yang sama dan 1 berbeda	
3.	Banyaknya susunan kue jika ketiga siswa masing-masing memperoleh jenis kue yang berbeda.	

6. Dari tabel 2, dapat kita peroleh sebagai berikut:

➢ Kejadian 1:

Menyusun kue agar ketiga siswa mendapatkan **jenis kue yang sama** dari tiga jenis kue berbeda yang tersedia. Hal ini dapat dilakukan dengan cara:

i. **Mengatur banyak cara memilih kue untuk orang pertama.**
Menurutmu, dari tiga jenis kue yang tersedia, kue apa saja yang dapat dipilihkan untuk orang yang pertama? Ada berapa banyak cara memilihnya? Jelaskan jawabanmu.

Jawab:

ii. **Mengatur banyak cara memilih kue untuk orang kedua.**
Oleh karena satu jenis kue sudah ditentukan untuk orang pertama, maka bolehkah dipilih kembali untuk orang kedua? Ada berapa banyak pilihan jenis kue untuk orang kedua? Jelaskan jawabanmu.

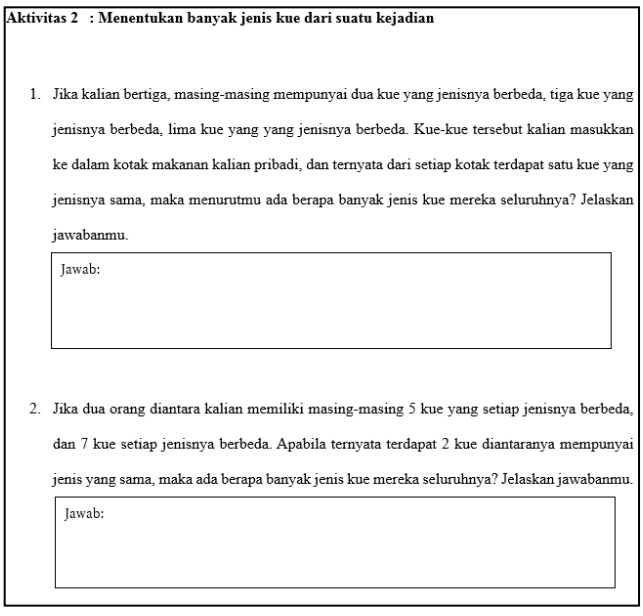
Figure 6. Questions on the LKPD

Figure 6 shows questions that will lead students to discover enumeration rules. The solution to this question is based on the results of the sample space analysis obtained previously. The ability of students to understand the concepts of sample space, points,

samples and enumeration rules can be seen well, this is related to the use of the context used. The context of market snacks is a familiar context among students. As said by Wijaya et al., (2021), that familiar context is a very important aspect for meaningful learning. Thus, based on the results of the researcher's observations, learning opportunities in the context of market snacks makes mathematics learning meaningful so that students can understand the concepts well so as to achieve the learning objectives that the researchers designed.

Understanding concepts using this context is also relevant to research by Sari et al., (2022), which uses the snakes and ladders game in learning probability material. Their research shows that the use of HLT in mathematics learning in this context can help students understand the concept of probability better. Thus, it can be said that using a context that is familiar to students can help students understand the concept of probability. It can be seen from the students' answers to the LKPD that the results are not much different from the HLT design that the researchers designed.

After students understand the concept of sample space, sample points, and numeration rules (multiplication rules), they will continue activity 2 which aims to understand enumeration rules (addition rules). In activity 2, the researcher designed two trigger questions that required reasoning to complete, as shown in **Figure 7**.



Aktivitas 2 : Menentukan banyak jenis kue dari suatu kejadian

1. Jika kalian bertiga, masing-masing mempunyai dua kue yang jenisnya berbeda, tiga kue yang jenisnya berbeda, lima kue yang yang jenisnya berbeda. Kue-kue tersebut kalian masukkan ke dalam kotak makanan kalian pribadi, dan ternyata dari setiap kotak terdapat satu kue yang jenisnya sama, maka menurutmu ada berapa banyak jenis kue mereka seluruhnya? Jelaskan jawabanmu.

   Jawab:

2. Jika dua orang diantara kalian memiliki masing-masing 5 kue yang setiap jenisnya berbeda, dan 7 kue setiap jenisnya berbeda. Apabila ternyata terdapat 2 kue diantaranya mempunyai jenis yang sama, maka ada berapa banyak jenis kue mereka seluruhnya? Jelaskan jawabanmu.

   Jawab:

Figure 7. Activity 2 on the LKPD

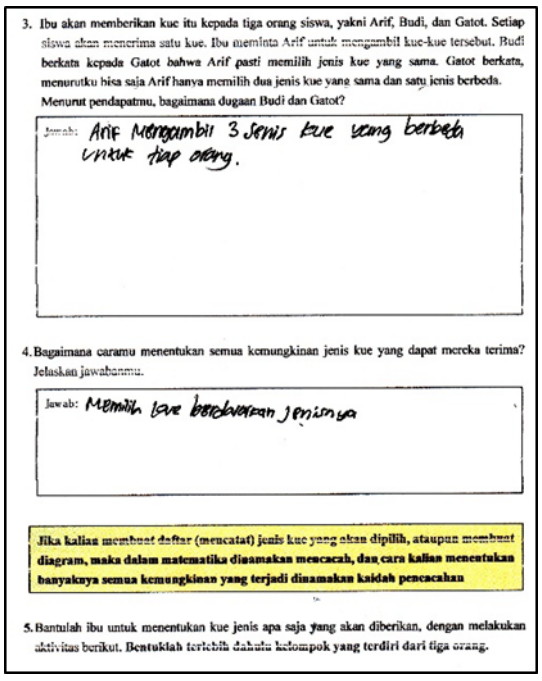
Figure 7 shows the 2 activities that researchers designed on the LKPD. Researchers provide two contextual problems, which require students' reasoning abilities to solve

them. At the design experiment stage (pilot experiment), students' answers to the LKPD design were produced. The LKPD was initially done individually, then discussed in each group. During the work, the researcher found students who had difficulty working on the LKPD and asked their group friends.

The difficulties experienced by students are related to problems that require reasoning, so that students make mistakes in interpreting problems. This researcher's findings are in line with research conducted by Astuti et al., (2020) which said that one of students' misconceptions about probability material is students' mistakes in interpreting questions. This also results in errors in calculating the number of events. Based on the researcher's observations, students tried to solve these problems by discussing with their groups.

As explained previously, the abilities of students in one group consist of students with high, medium, sufficient and low abilities. Based on the researcher's observations, if one of their friends in a group asks a question, the other friends also listen, and students who are more capable than the questioner provide assistance. The questioner does not ask the target friend directly, but seems to ask all his friends in the group.

One of the difficulties experienced by students is problem number three. The problem concerns Budi and Gatot's allegations, as seen in **Figure 8**.



Group 1 Answers

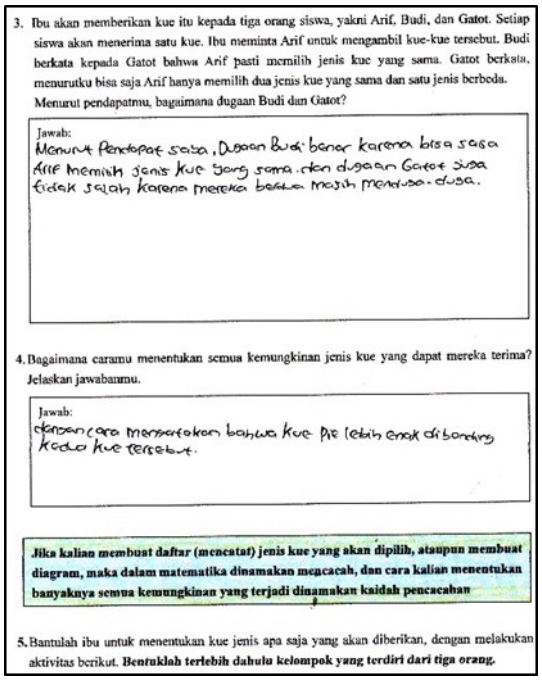
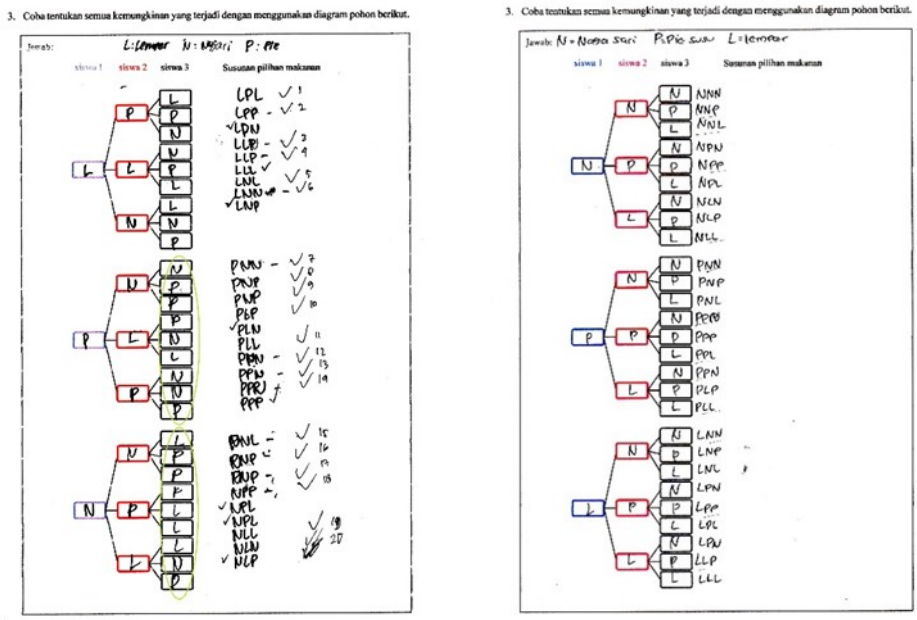


Fig. 8b. Group 2 Answers

Figure 8. Group answers to problem number 3

Based on **Figure 8**, it can be seen that group 1 experienced difficulty in solving problem number 3 on the LKPD. Group 2's answers were close to the researchers' expectations for HLT. Another difficulty that researchers found was determining the sample space using a tree diagram, as seen in **Figure 9**.



Group 1 Answers Group 2 Answers

Figure 9. Students' answers to Activity 1

Figure 9 shows the answers of both groups in activity 1, regarding determining the sample space using a tree diagram. It can be seen that group 1 experienced errors in the second and third charts (researchers circled green), while group II's answers were in line with the researchers' expectations. Likewise with activity 2, group II gave the correct answer, while group I did not answer. This is because they do not understand the meaning of the questions given on the LKPD, and this shows that group II's reasoning ability is better than group I.

The answers are still not in line with the researchers' expectations, because students' mathematical reasoning abilities need to be improved, as in research conducted by Sukmawati et al., (2023) which states that in general students who have high mathematical reasoning abilities have able to solve the questions given and more quickly understand the meaning of the questions. Meanwhile, students who have moderate mathematical reasoning abilities are not yet able to manipulate data like students who have high abilities. Students with low abilities still make a lot of mistakes in answering questions and don't even give any answers

Based on the researcher's observations during observations at the design experiment stage (pilot experiment) and also interviews, the difficulties experienced by the students were because they thought that solving problems in mathematics must be in the form of formulas, they were not used to reasoning answers that required other than mathematical formulas from contextual problems that the researcher provided. Even though the answers they give in the LKPD only enumerate the sample space and sample points to then direct them to the enumeration rules.

After completing the learning process and discussing the LKPD given, the researchers found that basically they understood the meaning of the questions given, but researchers need to develop reasoning abilities in students, and get used to using contextualization in learning so that mathematics learning becomes meaningful.

CONCLUSION

The conclusion from the research that the researchers have carried out is that the learning trajectory in the form of two activities that the researchers produced, namely the activity of choosing one type of cake for three people from three types of cakes available and determining the number of types of cakes from an event, can be seen as an alternative method for teachers to help Students learn the concepts of sample space, sample points, and enumeration rules. The context of the Prabumulih City market snacks that researchers used to design the HLT shows that this context is relevant, and through this context it helps students practice their mathematical reasoning related to probability material, the subject of enumeration rules.

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