Tarbawi: Jurnal Ilmu Pendidikan
p-ISSN: 1858-1080|e-ISSN: 2615-6547
Vol. 19, No. 2, December 2023, 101-112

Teaching the Rule of Product using Nature Tourism Routes

Aan Putra[1], Zulkardi[1], Ratu Ilma Indra Putri[1], Laswadi[2], Ely Susanti[1], Duano Sapta Nusantara[1]

[1] *Universitas Sriwijaya*
[2] *Institut Agama Islam Negeri Kerinci*
zulkardi@unsri.ac.id

Abstract. *A tourism route is a sequence of tourist destinations visited. Students are familiar with tour activities and often plan tourism routes to visit several tourist destinations. Students' experience and knowledge about tourism routes can be used as a context for teaching the rule of product. Therefore, this research aims to design a learning trajectory for the rule of product using the Indonesian Realistic Mathematics Education (PMRI) approach in the Kerinci nature tourism route context. The research method used is design research with a validation study type, which consists of three stages: preparation and design, teaching experiment, and retrospective analysis. The subjects involved in this research were 11 third-semester mathematics education students at a university in Jambi, Indonesia. The instruments include learning video recordings, student work results, field notes, and test sheets. The research results show that learning trajectories designed in the context of tourism routes can help students discover, understand, and use the rule of product in solving relevant mathematical problems. The learning tracjectory consists of four activities: making a list of Kerinci tourist destinations, determining the location of several tourist destinations on a sketch map, arranging tourist destinations in tourism routes, and solving problems regarding possible tourism routes. This research shows that the designed learning trajectory is vital in helping students discover and understand the rule of product and apply them to solving relevant problems.*

Keywords*: Design Research, Goetourism Context, Learning Trajectory, Realistics Mathematics Education, Rule of Product*

INTRODUCTION

Mathematics has a crucial role in various fields and everyday life. In an academic context, mathematics is a universal language that is the basis for other scientific disciplines (Waller & Flood, 2016), while in everyday life, mathematics is involved in various activities (Vinner, 2011). Logical thinking and problem-solving abilities developed through learning mathematics also help overcome daily challenges (Jonassen, 2000). Thus, mathematics is an academic skill and a fundamental tool for understanding the world, developing critical skills, and making decisions in various life contexts.

In decision-making, mathematics becomes an essential instrument for analyzing the available options. A good understanding of mathematics will be beneficial in exploring and investigating various options when faced with important decisions (Vinogradova, 2019). One of the mathematical topics that studies the possible choices of several objects that can be rearranged is the concept of enumeration rules. Enumeration rules allow us to systematically count and evaluate the various possible options (Charalambides, 2002). Mastery of enumeration rules, such as the rule of product, has great relevance in solving multiple problems in the real world (Matitaputty et al., 2022). This concept provides a powerful analytical tool for understanding and resolving situations involving regulatory elements.

The rule of product is also the basis for other enumeration rules such as permutations and combinations. Permutations and combinations are very important when the order of different elements affects the final result (Usry et al., 2016). These concepts are relevant in planning schedules, dividing tasks within a team (Younas, 2018), arranging chairs, or organizing events

(Lewis & Carroll, 2016). In addition to the immediate real-world benefits, a deep understanding of the rule of product, permutation, and combination is also an essential prerequisite for learning more complex mathematical topics. It provides a solid foundation for understanding concepts such as combinatorics, probability, and statistics, which have broad applications in various scientific disciplines (Batanero & Sanchez, 2005). Thus, mastering the rule of product is vital in solving practical problems and a crucial foundation for understanding and mastering mathematics more deeply. A meaningful learning approach is needed to address this goal.

Meanwhile, mathematics learning is generally mechanistic, making learning less meaningful (Barnes, 2005). This approach focuses on memorizing formulas and steps without providing a deep understanding of mathematical concepts. Students who learn mechanistically may be able to repeat specific procedures but often have difficulty applying that knowledge in real-world contexts (Liu & Schunn, 2017).

The Indonesian Realistic Mathematics Education (PMRI) approach is an alternative that can be used to realize meaningful learning for several reasons. First, the PMRI approach focuses on real contexts relevant to students' lives (Zulkardi & Putri, 2019). This approach helps students understand mathematical concepts in a context that they understand. Students who see how mathematics is applied in everyday life are more likely to remember and understand it (van den Heuvel-Panhuizen & Drijvers, 2020). Second, the PMRI approach involves students actively in the learning process. Students are encouraged to discover mathematical concepts, not just the teacher's understanding (Sembiring et al., 2008). Rediscovery of concepts helps students to build a deep understanding of mathematics.

Mathematical concept rediscovery activities can be expressed as learning trajectories using contexts that are relevant to students' daily lives or can be easily imagined by them (Clements et al., 2019). Students can build their knowledge from informal solutions to formal ones through the right learning trajectory (Antonides & Battista, 2022). Additionally, with a set of mathematical concepts with situations or problems familiar to students, they can see direct applications of what they learn daily. This way makes learning more exciting and helps students understand and internalize these concepts (Mumcu, 2018). For example, when learning the rule of product, we can plan activities that involve real situations and prepare a schedule for daily activities (Gionis et al., 2014). Students can see how these concepts can be applied to their own lives so they can relate them to their personal experiences.

Previous research on learning enumeration rules, especially the rule of product and permutation, has involved various contexts. These learning activities include activities using the context of towers (Antonides & Battista, 2022), beaded bracelets (Chotikarn et al., 2021), presentation sequences (Kimani et al., 2013), teddy bears (van Bommel & Palmér, 2021), and photography (Szydlik, 2000). These contexts were used in diverse samples ranging from preschool children to college students and prospective teachers. However, it can be concluded that the activities used involve objects that can be rearranged and are in accordance with students' knowledge and experience (Putra et al., 2023).

Using the context of tourism routes in teaching the rule of product is an appropriate alternative. This fact is based on the consideration that students belonging to Z-generation tend to be interested in tourism activities (Haddouche & Salomone, 2018). In other words, the context of the tourism route is very appropriate to students' knowledge and experience in real life. For example, in carrying out tourism activities, they are faced with choices regarding tourist destinations, effective and efficient visiting routes, and others (Awaritefe, 2004).

This research aims to produce a mathematics learning trajectory based on the Indonesian Realistic Mathematics Education (PMRI) approach using the context of natural tourism routes in Kerinci to help students understand the concept of the rule of product. Through this research, students' understanding and mastery of the rule of product topic can be optimized. Apart from that, it is hoped that the results of this research will be an alternative for teachers in teaching rule of product as well as being a reference for other teachers or researchers in developing learning

trajectories on similar topics in different contexts or developing learning trajectories with general tourism contexts for various mathematical topics.

METHOD

This research is a validation study type of design research. Validation studies focus on designing environments or learning trajectories to develop and validate theories about the learning process and describe the process of designing environments or learning trajectories (Plomp, 2007). The research aims to produce a hypothetical learning trajectory (HLT) based on the Indonesian Realistic Mathematics Education (PMRI) approach in the context of natural tourism routes in Kerinci to improve the quality of learning about the concept of the rule of product (Gravemeijer & van Eerde, 2009). The research involved 11 second year prospective mathematics teacher students at a university in Jambi, Indonesia. The research was carried out in three stages: preparing for the experiment, experimenting in the classroom, and conducting retrospective analysis (Gravemeijer & Cobb, 2006).

Preparation and Design

At this stage, the researcher carried out three activities to compile an initial design of a hypothetical learning trajectory (van Eerde, 2013). First, the researcher gave students a pretest of problems related to using enumeration rules. The pretest results revealed that students tend to do long enumerations, so they need more time to solve simple problems. Second, researchers conducted a literature review on various ways of teaching enumeration rules, especially the rule of product. From various literature it is found that the problems used to teach enumeration rules generally use the context of objects or objects which allow them to be arranged in various ways, for example the position of objects or the order of objects. Third, the researcher chose the context of the Kerinci tourism route and formulated a series of activities that students would carry out in learning, namely mentioning tourist destinations that were known, visited and recommended; sketch a map and determine the location of tourist destinations on the sketch map; determine many possible tourism routes for simple problems; and solve problems related to more complicated rule of product. This series of activities is presented in student group worksheets.

The information obtained from these activities is used to develop a hypothetical learning trajectory consisting of three components: learning objectives, learning activities, and the hypothesized learning process (Gravemeijer & Cobb, 2006), as presented in Table 1.

Table 1. Activities and Estimated Learning Process

Main Activities	Main Goal	Hypothetical Activities
Students mention tourist destinations that they know, have visited, and which they recommend visiting.	Mentioning tourist destinations in Kerinci Regency that they can choose to visit.	• Students name more tourist destinations. • Students name tourist destinations and their locations.
Students copied a map of Kerinci Regency and marked the locations of several tourist destinations.	Making a map model, determine the location of several tourist destinations, and connect them to roads.	• Students copy a map complete with main roads and tourist destination locations. • Students copy maps without main roads but try to determine the location of tourist destinations on the map.
Students choose 3 tourist destinations and determine the visiting route using a diagram.	Determining many possible routes to visit selected tourist destinations.	• Students enumerate all possible routes without a diagram. • Students use diagrams.
Students complete questions related to the rule of product.	Determining the number of possible tourism routes if some tourist destinations are visited.	• Students can relate solutions to the rule of product and provide logical arguments. • Students solve problems by copying the diagram from the previous activity.

Teaching Experiment

This stage is carried out in two phases, namely teaching experiments and pilot experiments (Bakker, 2018). Teaching experiments or initial HLT design trials were carried out involving three students working in one group to obtain input for improving the HLT design, especially regarding the readability of worksheets, clarity of instructions and commands, and attractiveness and suitability of the context used in students' daily lives. The results of the HLT design improvements were implemented in pilot experiments involving all students in one class. During the learning process, researchers collected data through learning observation videos, student answers on worksheets, field notes, and interviews (van Eerde, 2013) with students during the learning process, both group discussions and presentations of work results in front of the class.

Retrospective Analysis

Researchers compared the implementation of learning or actual learning trajectory (ALT) with the HLT that had been prepared (van Eerde, 2013). In addition, at this stage the researcher identifies how students discover, understand and use rule of product. Learning videos, field notes, and interview results were analyzed to find fixed moments that depict students' first understanding of the concept of the rule of product. The findings at this stage are used to explain the role of the context of the tourism route in helping students find, understand, and use the rule of product.

FINDINGS

This research develops a hypothetical learning trajectory based on the Indonesian Realistic Mathematics Education (PMRI) approach in the context of natural tourism routes in Kerinci to help students understand the concept of the rule of product. Some of the activities carried out by students in learning include writing a list of tourist destinations, determining the location of tourist destinations on a sketch of the map, determining the route to visit tourist destinations, and solving problems regarding the many possible visiting routes. In this research, the researcher also acts as a teacher. At the beginning of the lesson, start learning by reminding students that Kerinci Regency has been a tourism icon for Jambi province since 2016 and asking about tourist destinations that many tourists visit. This question aims to ensure their knowledge about the diversity of tourist destinations in Kerinci Regency.

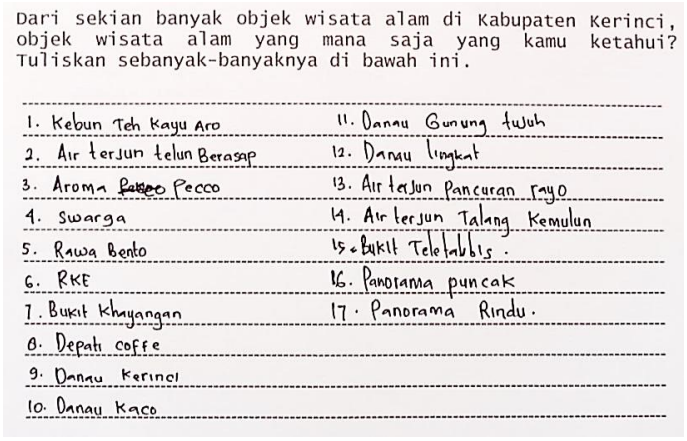
Dialogue 1 (Q = researcher; M = student)

Q : In Kerinci Regency, there are many tourist destinations, right? Which ones are visited by many tourists?
M : Kayu Aro (a highland tea farm), Danau Kerinci (a lake), and Bukit Khayangan (a hill).
Q : During Eid, have you ever visited more than one tourist destination in one day? What is the route?
M1 : Yes, Sir. Sometimes, we go to Aroma Pecco (a small lake), then continue the tour to the Air Terjun Telun Berasap (a waterfall). We stopped by Air Panas Semurup (a hot spring) when we got home.
Q : What about the others?
M2 : We visit the farthest one first, Sir. We will go to the Air Terjun Telun Berasap first. We will stop by Aroma Pecco and Air Panas Semurup when we come home.

Dialogue 1 shows that students already recognize various tourist destinations and have experience with various alternative routes for visiting several tourist destinations. Therefore, students' knowledge and experience regarding various ways to choose routes to visit tourist destinations can be used as a starting point in studying the rule of product topic. Next, the researcher spontaneously divided the students into groups of 2 to 3 people based on the location of their seats. The researcher gave worksheets to be done together in groups and asked students to discuss in groups and present their answers if asked.

Making a List of Tourist Destinations

At this stage, students are asked to make a list of tourist destinations they know, destinations they have visited, and destinations they most recommend visiting. Students mentioned more tourist destinations they knew about than they had visited and mentioned fewer objects they recommended tourists from outside Kerinci to visit. Different groups mentioned different tourist destinations based on their respective knowledge and experience. For example, some tourist destinations that group 1 members know about are shown in Figure 1.


Dari sekian banyak objek wisata alam di Kabupaten Kerinci, objek wisata alam yang mana saja yang kamu ketahui? Tuliskan sebanyak-banyaknya di bawah ini.

1. Kebun Teh Kayu Aro
2. Air terjun telun Berasap
3. Aroma ~~Bango~~ Pecco
4. Swarga
5. Rawa Bento
6. RKE
7. Bukit Khayangan
8. Depati coffe
9. Danau Kerinci
10. Danau Kaco
11. Danau Gunung tujuh
12. Danau lingkat
13. Air terjun Pancuran rayo
14. Air terjun Talang Kemulun
15. Bukit Teletabbis.
16. Panorama puncak
17. Panorama Rindu.

Of many nature tourism sites in Kerinci Regency, which ones did you know? Please write down as much as possible below.

(list of 17 nature tourism

Figure 1. List of Several Tourist Destinations in Kerinci Regency

Determining the Location of Several Tourist destinations on a Sketch Map

In this activity, students try to sketch a map of Kerinci ency according to the map example given on the worksheet and estimate the location of several tourist destinations on a copy of the map. Each group presents different tourist destinations from other groups. However, none of the groups connected tourist destinations with roads. Figure 2 is an example of determining the location of several tourist destinations on a sketch map made by group 2.

Figure 2. Sketch of Kerinci Regency Map and Location of Several Tourist Destinations

Arranging Tourist Destinations in Tourism Route

Each group chooses three tourist destinations that they might visit in one day and makes a list of route options for visiting these three tourist destinations. In Figure 3, students state there are only 6 possible routes to visit three tourist destinations. The first four possibilities are recommended routes while the other two are not because they require more time considering that Aroma Pecco

is in the middle of the crossing from Air Panas Semurup to Air Terjun Telun Berasap and vice versa.

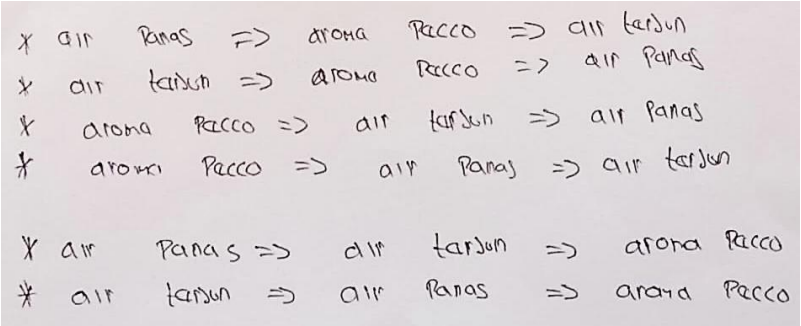
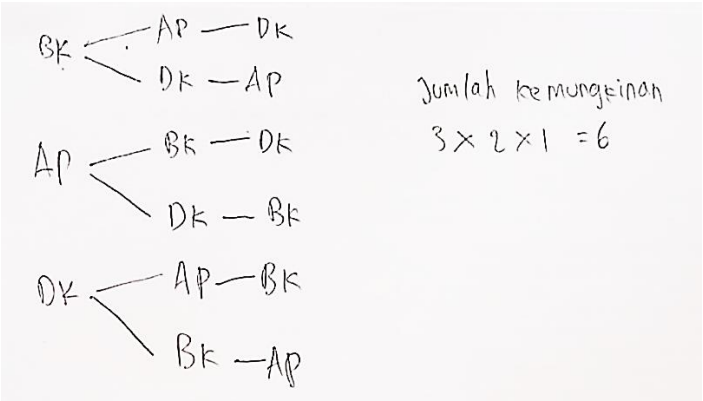


Figure 3. 6 Route Options for Visiting 3 Tourist Destinations

Another group solved the same problem using a tree diagram as shown in Figure 4. The three selected tourist destinations were symbolized by BK to represent Bukit Khayangan, AP to represent Air Panas Semurup, and DK to represent Danau Kerinci. The presentation in front of the class revealed that students assumed that if one tourist destination were chosen for the first visit (for example, BK), there would be two remaining tourist destinations that could be visited next, namely AP and DK. After two tourist destinations have been visited (for example, BK and AP), there will only be one choice of tourist destination left to visit, namely DK. The same thing will happen if the first tourist destination chosen is AP or DK. So there are 6 possible visiting routes for the three selected tourist destinations.

Students multiply 3, 2, and 1 to get the number of 6 possibilities. 3 means three possibilities on the first visit, 2 means two possibilities on the second visit, and 1 means one possibility on the third visit. Students use the cross sign because they see the branching in the diagram.



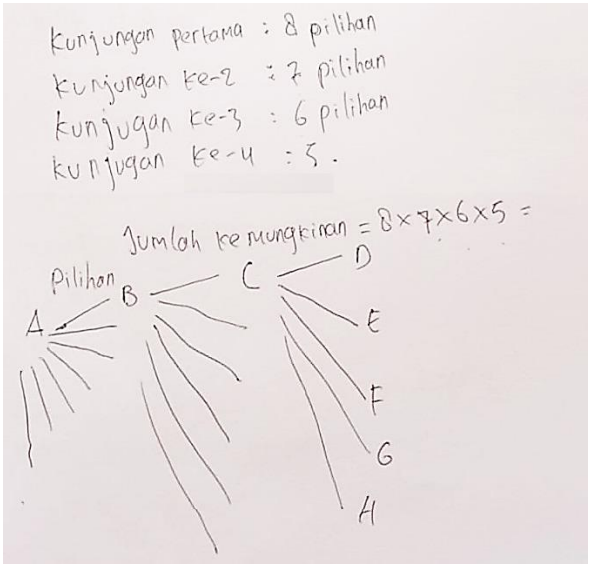
(tree diagram)

So, the number of different rearrange route is 3 × 2 × 1 = 6

Figure 4. Students Using Symbols and Diagrams

Solving Problems Regarding Possible Tourism Routes

At the end of the lesson, students are asked to solve problems regarding the many possible routes to visit 4 tourist destinations if 8 tourist destination choices are available. Even though they did not write down the final results of the calculations, students could explain the use of the concept of the rule of product, as shown in the students' answers in Figure 5. Students determined many choices on the first to fourth visits and then multiplied the many choices. To ensure their answer, students assume that after visiting one tourist destination (A), there will be 7 other tourist destination choices remaining. If the second tourist destination is visited (B), 6 more tourist destinations will remain, and so on.



In first visiting, there are 8 options
In secand visiting, there are 7 options
In third visiting, there are 6 options
In fourth visiting, there are 5 options

So, the number of different rearrange route is 8 × 7 × 6 × 5

(tree diagram)

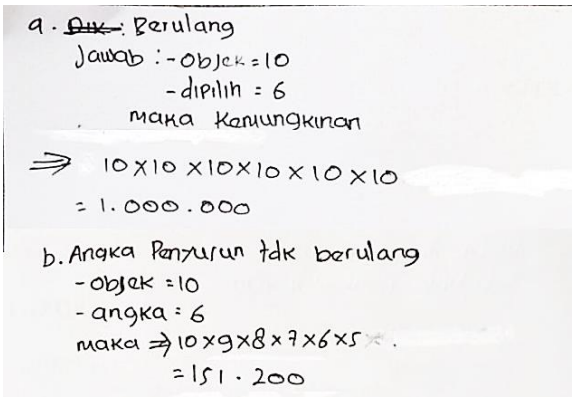
Figure 5. Students Solve Rule of Product Problems

From interviews, as in Dialogue 2, it was revealed that the diagrams made by students were used to check the answers they had made. Even though they used diagrams to check the correctness of answers, students carried out abstractions. In Figure 5, it can be seen that students only assume A is the first choice of visit and do not feel the need to assume that other tourist destinations (B to H) are chosen first but multiply it by eight.

Dialogue 2 (Q = researcher; M = student)
Q : Why is 8×7×6×5 not solved?
M : The important thing is that we know how to multiply it, Sir.
Q : Okay. Then, if you already know what to multiply, what is this diagram for?
M : To confirm our answer, Sir. Like the previous diagram.
Q : Why was not a complete diagram made for A to H?
M : Too many, Sir. This diagram is just an example, Sir. Then multiply it by 8, Sir.

Student Learning Outcomes

Based on the post-test results, there were significant changes in student learning outcomes, especially in solving problems related to the rule of product. Students can solve the problem of alternative arrangements for a 6-digit PIN (Personal Identification Number) if the numbers may or may not repeat themselves. In contrast to students' answers during the pretest, which included enumeration and did not finish, students' answers during the post-test used the rule of product without having to enumerate possible PIN arrangements. Examples of student answers are presented in Figure 6.



a. with repeatition
Whole objects = 10
Selected objects = 6
So, the number of different rearrange PIN is 10 × 10 × 10 × 10 × 10 × 10 = 1.000.000
b. without repetition
Whole objects = 10
Selected objects = 6
So, the number of different rearrange PIN is 10 × 9 × 8 × 7 × 6 × 5 = 151.200

Figure 6. Students Solve Problems Without Making a List of Possible PIN Arrangements

At the end of the lesson, the researcher gave several problems related to rule of product and students scrambled to answer orally. This condition indicates that students have succeeded in finding the rule of product through the learning process, understand them well, and can use their knowledge to solve problems related to the rule of product. This research also indicates that choosing the proper context outlined in appropriate learning activities can help students construct their knowledge by rediscovering mathematical concepts (Sitorus, 2016).

DISCUSSION

Existence of PMRI Principles

Indonesian Realistic Mathematics Education (PMRI) is an adapted form of Realistic Mathematics Education (RME). In its implementation, both in direct learning and using learning media, researchers must pay attention to 6 principles, namely the principle of activity, the principle of reality, the principle of levels, the principle of connection, the principle of interactivity, and the principle of guidance (van den Heuvel-Panhuizen & Drijvers, 2020).

Regarding activity principles, the developed HLT contains four main activities: writing a list of tourist destinations, determining the location of tourist destinations on a sketch of the map, determining the route of visiting tourist destinations, and solving problems regarding the many possible visiting routes. These activities are related to enumeration activities that humans naturally carry out intuitively. Activities that allow students to be active will help students understand mathematics as part of their daily activities (Hernandez-Martinez & Vos, 2018). Apart from that, the context used in HLT is a real context known and experienced by students, namely the problem of organizing and choosing tourism routes. Students in the Z-generation are known for their ethnic travel characteristics, so the chosen context interests students (Haddouche & Salomone, 2018). This statement follows the reality principle in PMRI.

In compiling HLT, researchers linked the rule of product topic with other mathematical concepts such as the concept of subsets and tree diagrams. Students are asked to list tourist destinations they know, have visited and are recommended to visit. In this activity, students choose recommended tourist destinations from a collection of tourist destinations they have visited and the tourist destinations they have visited are part of a collection of known tourist destinations. Many of the available ways of compiling tourism routes consisting of three tourist destinations are also related to how to compose subsets of sets with three members. This activity is in accordance with the principle of intertwinement in PMRI. Meanwhile, the main series of activities are arranged by considering the level of solutions given by students, starting from informal solutions by carrying out regular enumerations and using diagrams to formal solutions using the rule of product. This level principle allows students to formulate informal mathematical modeling into formal mathematics (Verschaffel et al., 2002).

In carrying out learning, students work with others so that interaction occurs between students both in their groups and with other groups, especially during presentations of work results. This interaction is in accordance with the principle of interactivity at PMRI, which views mathematics as a product of social interaction (Voigt, 2013). At the same time, there was guidance by researchers through trigger questions which triggered the emergence of cognitive conflicts in students. Not only that, guidance also occurs through directed questions and commands outlined in worksheets. The guidance carried out by researchers aims to direct students to discover, understand, and use the concept of the rule of product while confirming the results of students' work. This activity shows that the learning carried out is by PMRI's guiding principles.

The Role of Tourism Route Context

Using the context of tourism routes in mathematics learning differs from a method used by teachers or researchers. However, the context of a tourism route is the right choice for teaching

rule of product topic considering that a tourism route is a series of objects that can be rearranged to have many possible arrangements (Putra et al., 2023). The learning rule of product generally must involve objects that can be rearranged (Goulden & Jackson, 2004). Besides, tourism routes are a real problem known and experienced by students who generally enjoy traveling.

In tourism activities, tourists usually need help determining the choice of tourist destination from several available tourist destinations, effective and efficient alternative routes, choices and routes of rides to be enjoyed, and other problems involving choosing activities (Awaritefe, 2004). Selecting the most suitable alternative involves enumerating possible options before determining the option that best suits our desires. Problems with contexts that they know and experience make students more challenged to solve problems by using various methods according to their respective knowledge (Hajian, 2019).

One study has used a tourist context in mathematics learning. Students are challenged to design an itinerary package for a group of tourists who want to visit one of the resort islands in Singapore. The planning mainly includes planning a reasonable route to cover the places to be visited while considering the aspects of distance, time, and costs framed in certain task conditions (Chan, 2013).

CONCLUSION

The PMRI approach is a learning alternative to help students discover, understand, and use mathematical concepts to solve relevant mathematical problems. In this research, the PMRI approach in the context of tourism routes is presented through HLT, which consists of four activities considering the 6 PMRI principles to help students construct knowledge about the rule of product. These activities include mentioning tourist destinations that are known, visited and recommended; sketching a map and determine the location of tourist destinations on the sketch map; determining many possible tourism routes for simple problems; and solve more complicated problems related to the rule of product. At the end of the lesson, students demonstrate a good understanding of the concept of the rule of product and can solve relevant mathematical problems. Therefore, other teachers or researchers can use this learning trajectory to teach the rule of product with some adjustments.

REFERENCES

Antonides, J., & Battista, M. T. (2022). A learning trajectory for enumerating permutations: Applying and elaborating a theory of levels of abstraction. *The Journal of Mathematical Behavior, 68,* 101010. https://doi.org/10.1016/j.jmathb.2022.101010

Antonides, J., & Battista, M. T. (2022). Towards an elaboration of concreteness fading: Reflections on a constructivist teaching experiment. In *Proceedings of the 44th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Middle Tennessee State University.

Awaritefe, O. (2004). Motivation and other considerations in tourist destination choice: A case study of Nigeria. *Tourism Geographies, 6*(3), 303-330. https://doi.org/10.1080/1461668042000249638

Bakker, A. (2018). *Design research in education: A practical guide for early career researchers.* Routledge. https://www.routledge.com/Design-Research-in-Education-A-Practical-Guide-for-Early-Career-Researchers/Bakker/p/book/9781138574489

Barnes, H. (2005). The theory of Realistic Mathematics Education as a theoretical framework for teaching low attainers in mathematics. *Pythagoras, 2005*(61), 42-57. https://doi.org/10.4102/pythagoras.v0i61.120

Batanero, C., & Sanchez, E. (2005). What is the Nature of High School Students' Conceptions and Misconceptions About Probability?. In Jones, G. A. (Eds). *Exploring probability in school: Challenges for teaching and learning* (pp. 241-266). Springer. https://doi.org/10.1007/0-387-24530-8_11

Chan, C. M. E. (2013). Students' designing an ideal tourism route as mathematical modelling. In G. Stillman, G. Kaiser, W. Blum, & J. Brown. (Eds). *Teaching mathematical modelling: Connecting to research and practice* (pp. 153-163). Springer. https://doi.org/10.1007/978-94-007-6540-5_13

Charalambides, C.A. (2002). *Enumerative Combinatorics (1st ed.).* Chapman and Hall/CRC. https://doi.org/10.1201/9781315273112

Chotikarn, N., Kanhapong, A., Tupsai, J., & Yuenyong, C. (2021, March). Enhancing Grade 11 students' representation and connection in permutation and combination for their problem solving. In *Journal of Physics: Conference Series* (Vol. 1835, No. 1, p. 012023). IOP Publishing. https://doi.org/10.1088/1742-6596/1835/1/012023

Clements, D. H., Sarama, J., Baroody, A. J., Joswick, C., & Wolfe, C. B. (2019). Evaluating the efficacy of a learning trajectory for early shape composition. *American Educational Research Journal, 56*(6), 2509-2530. https://doi.org/10.3102/0002831219842788

Gionis, A., Lappas, T., Pelechrinis, K., & Terzi, E. (2014, February). Customized tour recommendations in urban areas. In *Proceedings of the 7th ACM International Conference on Web Search and Data Mining* (pp. 313-322). https://ssrn.com/abstract=2465142

Gravemeijer, K., & Cobb, P. (2006). Design research from a learning design perspective. In J. van den Akker, K. Gravemeijer, S. Mckenney, & N. Nieveen (Eds.). *Educational Design Research* (pp. 15-51). Routledge. https://doi.org/10.4324/9780203088364

Gravemeijer, K., & van Eerde, D. (2009). Design research as a means for building a knowledge base for teachers and teaching in mathematics education. *The Elementary School Journal, 109*(5), 510-524. https://doi.org/10.1086/596999

Haddouche, H., & Salomone, C. (2018). Generation Z and the tourist experience: tourist stories and use of social networks. *Journal of Tourism Futures, 4*(1), 69-79. https://doi.org/10.1108/JTF-12-2017-0059

Hajian, S. (2019). Transfer of learning and teaching: A review of transfer theories and effective instructional practices. *IAFOR Journal of Education, 7*(1), 93-111. https://doi.org/10.22492/ije.7.1.06

Hernandez-Martinez, P., & Vos, P. (2018). "Why do I have to learn this?" A case study on students' experiences of the relevance of mathematical modelling activities. *ZDM Mathematics Education, 50,* 245-257. https://doi.org/10.1007/s11858-017-0904-2

Jonassen, D. H. (2000). Toward a design theory of problem solving. *Educational Technology Research and Development, 48*(4), 63-85. https://doi.org/10.1007/BF02300500

Kimani, P. M., Gibbs, R. T., & Anderson, S. M. (2013). Restoring order to permutations and combinations. *Mathematics Teaching in the Middle School, 18*(7), 430-438. https://doi.org/10.5951/mathteacmiddscho.18.7.0430

Lewis, R., & Carroll, F. (2016). Creating seating plans: a practical application. *Journal of the Operational Research Society, 67*(11), 1353-1362. https://doi.org/10.1057/jors.2016.34

Liu, A. S., & Schunn, C. D. (2017). Applying math onto mechanisms: Mechanistic knowledge is associated with the use of formal mathematical strategies. *Cognitive Research: Principles and Implications, 2*(6), 1-13. https://doi.org/10.1186/s41235-016-0044-1

Matitaputty, C., Nusantara, T., & Hidayanto, E. (2022). Examining the pedagogical content knowledge of in-service mathematics teachers on the permutations and combinations in the context of student mistakes. *Journal on Mathematics Education, 13*(3), 393-414. https://doi.org/10.22342/jme.v13i3.pp393-414

Mumcu, H. Y. (2016). Using Mathematics, Mathematical Applications, Mathematical Modelling, and Mathematical Literacy: A Theoretical Study. *Journal of Education and Practice, 7*(36), 80-96. https://iiste.org/Journals/index.php/JEP/article/view/34638

Palmér, H., & van Bommel, J. (2022, May). Young students' choice of representation when solving a problem-solving task on combinatorics. In *A Mathematics Education Perspective on early Mathematics Learning – POEM 2022 Gothenburg*. Sweden. https://www.kau.se/files/2022-05/POEM_Palme%CC%81r_vanBommel.pdf

Plomp, T. (2007). Educational Design Research. In T. Plomp & N. Nieveen (Eds). *An introduction to educational design research* (pp. 9-35). SLO. https://slo.nl/publish/pages/4474/educational-design-research-part-a.pdf

Putra, A., Zulkardi, Z., Putri, R. I. I., & Nusantara, D. S. (2023). Scoping Literature Review: What Activities Can Help Students Discover Permutations?. *Edumatika : Jurnal Riset Pendidikan Matematika, 6*(2). https://doi.org/10.32939/ejrpm.v6i2.3167

Sembiring, R. K., Hadi, S., & Dolk, M. (2008). Reforming mathematics learning in Indonesian classrooms through RME. *ZDM Mathematics Education, 40*, 927-939. https://doi.org/10.1007/s11858-008-0125-9

Sitorus, J. (2016). Students' creative thinking process stages: Implementation of realistic mathematics education. *Thinking Skills and Creativity, 22*, 111-120. https://doi.org/10.1016/j.tsc.2016.09.007

Szydlik, J. E. (2000). Photographs and committees: Activities that help students discover permutations and combinations. *The Mathematics Teacher, 93*(2), 93-96. https://doi.org/10.5951/MT.93.2.0093

Usry, R., Rosli, R., & Maat, S. M. (2016). An error analysis of matriculation students' permutations and combinations. *Indian Journal of Science and Technology, 9*(4), 1-6. https://doi.org/10.17485/ijst/2016/v9i4/81793

van Bommel, J., & Palmér, H. (2021). Enhancing young children's understanding of a combinatorial task by using a duo of digital and physical artefacts. *Early Years, 41*(2-3), 218-231. https://doi.org/10.1080/09575146.2018.1501553

van den Heuvel-Panhuizen, M., & Drijvers, P. (2020). Realistic Mathematics Education. In S. Lerman (Ed.). *Encyclopedia of Mathematics Education* (pp. 713-717). Springer. https://doi.org/10.1007/978-3-030-15789-0_170

van Eerde, D. (2013, April). Design research: Looking into the heart of mathematics education. In Zulkardi (Ed). *Proceeding The First South East Asia Design/Development Research (SEA-DR) International Conference.* (pp. 1-11). UNSRI, Palembang. https://repository.unsri.ac.id/5988/1/k1_dolly_10.pdf

Verschaffel, L., Greer, B., & De Corte, E. (2002). Everyday knowledge and mathematical modeling of school word problems. In K. Gravemeijer, R. Lehrer, B. Oers, & L. Verschaffel (Eds). *Symbolizing, modeling and tool use in mathematics education* (pp. 257-276). Springer. https://doi.org/10.1007/978-94-017-3194-2_16

Vinogradova, I. (2019). Multi-attribute decision-making methods as a part of mathematical optimization. *Mathematics, 7*(10), 915. https://doi.org/10.3390/math7100915

Vinner, S. (2011). The role of examples in the learning of mathematics and in everyday thought processes. *ZDM Mathematics Education, 43,* 247-256. https://doi.org/10.1007/s11858-010-0304-3

Voigt, J. (2013). Negotiation of mathematical meaning in classroom processes: Social interaction and learning mathematics. In L. P. Steffe et al. (Eds). *Theories of mathematical learning* (pp. 21-50). Routledge. https://doi.org/10.4324/9780203053126

Waller, P. P., & Flood, C. T. (2016). Mathematics as a universal language: transcending cultural lines. *Journal for Multicultural Education, 10*(3), 294-306. https://doi.org/10.1108/JME-01-2016-0004

Younas, I., Kamrani, F., Bashir, M., & Schubert, J. (2018). Efficient genetic algorithms for optimal assignment of tasks to teams of agents. *Neurocomputing, 314,* 409-428. https://doi.org/10.1016/j.neucom.2018.07.008

Zulkardi & Putri, R. I. I. (2019). New School Mathematics Curricula, PISA and PMRI in Indonesia. In C. Vistro-Yu & T. Toh (Eds). *School Mathematics Curricula. Mathematics Education – An Asian Perspective.* Springer. https://doi.org/10.1007/978-981-13-6312-2_3