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THE IMPACT OF INTEGRATED MICROLEARNING MEDIA IN STUDENT WORKSHEET IN PROBABILITY ON STUDENTS' REASONING ABILITIES

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Abstract. This research aims to design a student worksheet based on microlearning media in probability for 10th-grade students. The worksheet was developed using microlearning-based Indonesia Realistic Mathematics Educaion approach using the culinary tourism context of Prabumulih City to help students learn the probability in 10th grade students and train their reasoning abilities. This research used the research and development method, which consists of two stages, namely, preliminary research and formative evaluation. The subjects of this research were 35 students of grade 10th SMAN 6 Prabumulih. Data were collected through observation, tests, and interviews. Data analysis shows that with the worksheet, students' reasoning ability is sufficiently good. Therefore, it is included that students' worksheets in probability based on microlearning media support students' reasoning abilities.

Keywords: Development research, Microlearning-based in probability, Reasoning ability

1. Introduction

Probability is an important subject and an obligatory learning content in senior high school education. This fact can be seen from the inclusion of probability content in the school curriculum, Merdeka Curriculum, and also in PISA. Therefore, this is one of the important topics in mathematics for students to learn. According to Vásquez et al. (2021), issues related to uncertainty and risk in the real world must be promoted so that citizens can make rational decisions when facing real-world challenges. In the Indonesian curriculum, uncertainty content is included in analyzing data and probability. Although both are different fields of mathematics, they can go hand in hand (Arican & Kuzu, 2020). If statistics focuses on collecting, retrieving, and analyzing data, probability discussing the possibility of an even occuring.

Probability is one of the areas of knowledge that can be used to train students' reasoning abilities because to determine the probability of an event, students need to understand the sample space that requires reasoning. This is related by Konold et al. (1993) who said that students use their reasoning abilities to estimate all possible outcomes that can occur from an experiment. In addition, according to Álvarez-Arroyo et al. (2024), Probability knowledge is essential for students because they often encounter random situations, such as media analysis, risky decision making. Thus it can be said that students' reasoning abilities can be trained throw learning probability.

Reasoning ability is one of the problems in mathematics in school, including learning probability. According to Arican & Kuzu (2020), One of the mistakes students make in learning probability is understanding independent and dependent events and determining the probability value of two events.

In the Merdeka Curriculum, the learning outcomes of probability in 10th grade are that students can explain probability and determine the expected frequency of compound events, as well as investigate the concept of independent and mutually exclusive events and determine their probability (BSKAP, 2024). Misconceptions in solving probability problems include errors in interpreting questions (Astuti et al., 2020).

Those shortcomings can be caused by the learning resources used not utilizing enough context in mathematics learning. This is also related to low student learning outcomes. Hiltrimartin et al., (2022) stated that students still have problems understanding concepts, so their learning outcomes are low. She

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further said those shortcomings can be caused by the selection of inappropriate learning models, methods, or approaches.

According to (Maulana et al., n.d.), The world's education system pays great attention to the quality of teaching and students' learning outcomes through optimizing the learning process by investing significant resources. Thus, in learning mathematics, it is necessary to utilize the context and use appropriate learning models or methods.

Two of the learning resources that students use to learn are textbooks and student worksheets. According to Yunianta et al., (2023) textbooks have great potential to help students understand mathematical concepts. Most mathematics textbooks present material only as interesting objects without exploring a deeper understanding of concepts and their use (Batanero & Álvarez-Arroyo, 2024). Micro-based learning can provide opportunities for students to learn more deeply about probability. The use of culinary tourism context can make learning more meaningful and enjoyable.

Putri et al. (2022) said that there need to be learning activities that can make students active in learning and train their reasoning abilities. In addition, teachers can use the right approach in learning, as well as interesting learning media.

One approach that can be used in mathematics learning is PMRI (Indonesian Realistic Mathematics Education), which is an approach adopted from RME (Realistic Mathematics Education). Zulkardi et al. (2020) stated that PMRI is a didactic approach specifically for the mathematics domain adapted from RME. PMRI learning starts from the real context or situation experienced by students to connect informal to formal mathematics (Putri & Zulkardi, 2020).

This approach is suitable for this research gap; by designing learning that begins with the use of context, students are led to understand concepts so that they can train their reasoning abilities. In addition to using context, researchers use microlearning media to bridge students from informal to formal mathematics. The researcher used culinary tourism in the city of Prabumulih, South Sumatra, as context and comic as microlearning media. Through this context, which is packaged in microlearning media, a comic, it guides students to understand the concept of sample space and is integrated into a worksheet to train their reasoning abilities in solving the problems that are given related to probability. The use of context is one of the efforts the teachers can use to improve the quality of learning so that learning becomes more meaningful.

Many contexts have been used in learning probability, including the snakes and ladder game (Kurnianingsih et al., 2023), market snack (Sakiman et al., 2023), Maritime (Malalina et al., 2024). Those contexts are used by researchers to bridge students' understanding of the concept of probability. In this research, the researcher uses culinary tourism in the city of Prabumulih as a context in learning probability. Compared to the media used by the other researchers, the microlearning media used by the researcher is a solution for learning probability in a different form.

For information to be delivered well, microlearning media focusing on mathematics concepts, the material should be devided into several small loads so that students can more easily digest, remember, and understand the information obtained. Microlearning media can be used to deliver brief information. As stated by Dolasinski & Reynolds (2020), Microlearning is an approach that focuses on concepts, utilizing multisensory and multimodality in a short and focused time. Each learning unit is designed to focus on one or more key concepts. Aldosemani (2019), McNeill & Fitch (2023) said that microlearning helps make connections between topics and ideas while learning and can improve students' focus and concentration, as well as their knowledge retention.

Thus, it can be said that in order for students to more easily understand the concept of probability, the learning material of probability needs to be divided into small parts so that they can focus on one concept at a time. Microlearning can help students to be more focused and concentrated in learning, as well as in the retention of the knowledge gained.

There have been many real contexts related to the lives of students used is several researches, as previously described. Unfortunately, those real contexts are only presented on students' worksheets, which are then equipped with story illustrations with fairly long sentences. In this research, the

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researcher offers learning innovation by presenting real context into microlearning media, in the form comic and video.

The comic contains a conversation between two girls who are going to buy souvenirs. They will draw prizes provided by the shop. Through this conversation, students are guided to understand the concept of sample space and events.

The video contains information about presenting sample space in a tree diagram. The real context used is relevant to the comic. Students are guided to understand all the possible outcomes that arise from the spin wheel to get a prize.

This research combines the PMRI (Indonesian Realistic Mathematics Education) approach with microlearning. The researcher presents the real context in microlearning media, which is then integrated into the student's worksheet, as a discussion for students in understanding the concept of probability and also to train their reasoning abilities.

The objective of this research is to determine how the impact of microlearning media integrated into student worksheets on students' reasoning abilities. So, in this paper, the researcher will present the results of the research in the form of the impact of microlearning media integrated into students' worksheets on students' reasoning abilities.

2. Methods

This research used research and development, which consists of preliminary study and formative evaluation (Tessmer, 1994.) The preliminary study was done by analyzing the curriculum, theory, and students who are the subject of this research, namely students garde 10 that consists of 35 students. The data collection techniques in this study were observation, test, and interview, which were analyzed descriptively.

In the preliminary stage, the researcher developed microlearning mediums, namely comics and video. Then, we designed student worksheets on probability as prototype 1. The instruments that the researcher has created are adapted to the characteristics of the students who are the subject of this research.

The real context that the researcher used was culinary tourism in Prabumulih City, South Sumatra. The researcher uses that context because it is close to students' daily lives and highlights Indonesian culture in the culinary field as a characteristic of PMRI. The students can see how mathematics is used in real situations, so that learning probability becomes meanigful to train their reasoning abilities.

The context that the researcher uses is supported by the report of Putri & Zulkardi, (2020) explained that teaching materials can use the real context of students. The context of culinary tourism acts as a bridge that leads students from informal to formal mathematics regarding learning material on probability. The use of this context is an effort by a researcher as an innovative teaching to make learning more meaningful so that students can understand the concept of the probability and tran their resoning abilities.

Armiati et al. (2022) said that innovative teaching materials and learning methods are essential to help students understand and overcome difficulties in probability. In probability, students have to learn about sample space. The relationship between the sample space and the context of culinary tourism can be seen from the contents of the comic, namely in determining the sample space from the experiment of the spin wheel.

In the formative evaluation, the researcher has used four basic formative evaluation, namely expert review; one to one evaluation; small group evaluation; and field test evaluation (Tessmer, 1994). In the expert review, prototype 1 was submitted to content experts and subject specialists for review. In one-to-one evaluation, prototype 1 was reviewed on four students, who were not subject of this research. Each student reviewed the prototype with the evaluator (researcher) and commented upon it while the

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researcher took notes. In small group evaluation, the researcher tried out a rough draft of prototype (prototype 2) with several students, observed their performance and comments. The researcher observed students' conceptional understanding and reasoning abilities during prototype work. In this research, the researcher only focuses on their reasoning abilities. What the researcher observed through the observation sheet related to students' reasoning abilities was the ability to analyze and provide reasons for the answers given. In field test evaluation, the researcher observed a polished prototype version (prototype 3) tried out with 35 students from grade 10 senior high school in a realistic instructional setting, followed by students and researcher debriefing.

The researcher used the N-Gain formula to process pre-test and post-test data given to 35 students. The classification of N-Gain values can be seen in Table 1.

Table 1. Classification of Gain Normality Values

Average N-Gain	Categories
$N-Gain \geq 0{,}7$	High
$0{,}3 < N-Gain < 0{,}7$	Moderate
$N-Gain \leq 0{,}3$	Low

3. Results and Discussion

3.1. Results

In the preliminary study, the researcher produced microlearning media in the form of a comic with the context of culinary tourism in Prabumulih City. The comic is about two people who are shopping at one of the culinary places in Prabumulih City and win a prize for the city's local food. Through this context, students are directed to understand the concept of sample space from an experiment, namely a spin wheel. This is in line with the characteristics of PMRI.

The comic that the researcher designed can be seen at the following comic. The comic is integrated into the student worksheet as a prototype, which leads students to understand the concept of probability as a support to train their reasoning ability.

In formative evaluation, the researcher produced experts' comments, and student answers on students' worksheets were used as a basis to improve prototype 1 into a valid prototype 2. From here, the researcher added microlearning media about tree diagrams. It cab be seen at the following tree diagrams. In the small group stage, the researcher obtained students' answers, which were analyzed to determine the practicality of prototype 2.

During one-to-one and small group stages, the researcher also generated field notes during the students' worksheet work as a result of observations and interviews, which were then used as considerations for revising. Changes from prototype 1 to 2 can be seen in the following prototype 2.

From the result of the analysis of students' answers, the researcher obtained a valid and practical prototype 2. The prototype was tested in the field test stage with 35 students. This stage produces students' answers on students' worksheets. This stage also produces pre-test and post-test results, which can be seen in Table 2.

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Table 2. Classification of Gain Normality Values

Test	Class Average Value	N-Gain Score	Categories
Pre-test	24,17	0,56	Moderate
Post-Test	65,69		

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From Table 2, the result of the N-gain score obtained based on the average pre-test and post-test values are 0,56. The number shows that the microlearning media integrated to the student worksheet on probability has a moderate effect on students' reasoning abilities. This means that students' reasoning abilities are sufficiently good.

3.2. Discussion

This research designed a student worksheet that integrated microlearning media, namely comics and videos. Through comics, researchers try to convey information about the concept of sample space, while video learning is the presentation of sample space by tree diagrams. Through the mirolearning media available in the student worksheet, it's seen that students easily solve the contextual problem given. This is related to the view Aldosemani, (2019), Microlearning can improve students' focus and concentration in understanding one concept in a short time.

The context of culinary tourism in Prabumulih City makes learning meaningful. During learning, students can easily understand the concept of sample space and probability. Thus, the context acts as a bridge that leads students from informal mathematics to formal mathematics. Through the context presented in microlearning media (informal mathematics), students can build their concept about sample space (formal mathematics) while also training their reasoning skills.

From the results of the pre-test and post-test, an increase can be seen, so it refers to the moderate category or can be said to be sufficiently good. Based on the interview with the teacher at the school, this is already an achievement to the subject of this research, because usually only 14% of students have good conceptual understanding ability. Thus, the microlearning media integrated into the student worksheet on probability with the context of culinary tourism in Prabumulih City can help improve students' reasoning abilities.

4. Conclusion

Microlearning media that are integrated into student worksheets on probability with the context of culinary tourism in Prabumulih City has an impact on students' reasoning abilities. It is relevant to their conceptual understanding of probability. This impact can be seen from the N-gain calculation of pre-test and post-test achievement, which shows that the students' reasoning abilities are sufficiently good.

A limitation of this research is the lack of understanding of teachers regarding probability. The researcher suggests that teachers improve themselves first in understanding about probability. Start with one subtopic with one achievement indicator, and package the material learning in the form of microlearning.

Future research can further investigate the impact of microlearning media on student' abilities, complemented by their communication and collaboration abilities by continuously refining and adapting this approach.

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