International Conference on Teaching and Learning Proceeding
Faculty of Education and Teacher Training – Universitas Terbuka
UTCC, South Tangerang, Banten, May 15th 2025
Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

EFFECTIVENESS OF LEARNING PROBABILITY BASED ON MICROLEARNING MEDIA TO STUDENTS' REASONING ABILITY

Novi Komariyatiningsih[1], Yusuf Hartono[2*], Ratu Ilma Indra Putri [3], Cecil Hiltrimartin [4]
[1,2,3,4]Mathematics Education Department, Sriwijaya University, South Sumatera, Indonesia
email: yhartono@unsri.ac.id

Abstract: Students' reasoning ability is still a problem in mathematics learning, as seen from several research results of researchers related to reasoning ability in probability material. The weakness of reasoning ability is partly due to students' lack of understanding of the concept of probability. Given the importance of the material, researcher innovate using microlearning media in the form of interactive videos, and student worksheets, so that students can understand the concept of probability material, which directly help their reasoning ability. This study aims to investigate the effectiveness of microlearning media in learning probability material. This study is development study with a formative evaluation methods, namely preliminary study and formative evaluation. The subject of this study were 34 students grade 10 students senior high school. Data collection techniques were carried out by observation, tests, and interview, which were alayzed descriptevly. This study produce student worksheets and interactive videos as microlearning media. The results of the study showed that video greatly helped students work on worksheet, that led them to understand the concept, so that the learning became effective. Based on result of the data analysis, it was obtained that microlearning media made learning probability material effective to help students' reasoning ability.

Keywords: probabilty; microlearning media; reasoning ability.

Accepted: 30 April 2025 Approved: 14 May 2025 Published: 01 July 2025

INTRODUCTION

Probability is one of the contents contained in the Merdeka curriculum and in PISA (Programme for International Student Assessment). Probability discusses uncertainty, a topic which is included in data analysis and probability in the Indonesian curriculum. Although both are different fields of mathematics, they can go hand on hand (Arican & Kuzu, 2020), probability discussing the possibility of an even occuring. Vásquez et al., (2021) stated to uncertainty and risk in the world should be promoted, so that citizens can make rational decisions in facing real world challenges. Thus, it can be said that the material on probability is important to learn.

In the material on probability to determine the probability of an event, students need to

Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

estimate all the possibilities that can occcur from an experiment, namely the sample space. Therefore, students' reasoning abilities are needed to predict it. 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 Alvarez-Arroyo et al. (2024), probability knowledge is essential for students, because they often encounter random situations, such as media analysis, risky decision making.

Reasoning ability is one of the problem in mathematics in school, including the probility material. According Arican & Kuzu, (2020), on of the mistakes students make in probability material is understanding independent and dependent event, and determining the compoubd event probability. This topic is suitable with the content of probability material in merdeka curriculum which is focus of reseracher.

The learning outcomes of probablity material in the merdeka curriculum are 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 the probability (BSKAP, 2024.).

One of the reasons why students have difficulties in reasoning is due to the learning materials or media they use. In school learning, students usually use textbooks. Most mathematics books present material content only as interesting object without exploring deeper understanding of concept and the utility (Batanero & Álvarez-Arroyo, 2024). Hiltrimartin et al., (2022) said something similar, students worksheet often doesn't present problems that are relevant to daily life, only contains a summary of the material without any instruction for working on it. So that students are less motivated and have difficulty solving the problem given. Thus in general, students' reasoning problems are greatly influenced by the inadequate quality of teaching materials.

To resolve those problems, it is necessary to implements strategies in instructional actvities. According Putri et al., (2022), there needs to be learning activities that can make students active and develop creative skills in mastering the material. In addition, teacher can uses the right approach in learning, as well as interseting learning media. The result of their research are relevant to students' reasoning abilities, as can be seen from the students' creativity in understanding the material.

In learning mathematics, there is a special approach that can be used, namely PMRI (Indonesian Realistics Mathematics Education). Zulkardi et al.,(2020), said that PMRI is a didactic approach specifically for the mathematics domain adapted from RME (Realistic Mathematic Education). PMRI learning starts from the real context or situation experienced by students to connect informal to formal mathematics (Putri & Zulkardi, 2020) .

Some media or teaching materials that utilize contexts that can be used in learning probability material include the snake and ladders game (Kurnianingsih et al., 2023); market snacks (Komariyatiningsih et al., 2023); Maritime (Malalina et al., 2024) Those contexts are used to bridge students understanding of the concept probability. In this study the researcher used a different context, namely culinary tourism in the Prabumulih City.

Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

This context is used to design learning materials, which can help train students' reasoning abilities.

In order for information to be delivered well, the material should be devided into several partitions with a focus on mathematical concepts. So that students can more easily digest, remember, and understand the information obtained. Learning media that can be used to deliver brief information is microlearning-based media. This statement is supported by the results of report from several researchers. Dolasinski & Reynolds, (2020), microlearnig is an approach that focusses on concept, utilizing multisensory and multimodality in a short and focused time. Another opinios, (Aldosemani, 2019); (McNeill & Fitch, 2023), says that microlearning help make connection between topic and ideas while learning, and can improve students' focus and concentration, as well their knowledge retention.

Thus it can be said that in order for students to more easily understand the concept of mathematical material, in this case the probability material. Then the material needs to be devided 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 retention of the knowledge gained.

In this study, the microelarning media for the probability material that researcher designes was topic of mutually exclusive compound events, using interactive videos. Then design several activities in students worksheet as a bridge to understand the concept of probability material. This is the novelty about this study. The context used by more researchers is generally presented in the form of photos, which are the suplemented with several question as a bridge from informal mathematics to formal mathematics. While in this study, researcher uses the context in microelarning media in form interactive videos, students worksheet as a facility to help students' understanding the concept of probability material more deeply and students' reasoning abilities. The design of this probability material aims to help students learn probability material and train their reasoning abilities.

METHOD

The researcher used a design research method of the development studies type with formative evaluation which aims to produce teaching materal on topic probability in the form of microlearning media and students worksheet containing effective and efficent learning activities to improve the quality of learning so as to help train student reasoning abilities. These activities are a bridge that can help students understan the concep of mutually exclusive probability, as charactersitics of PMRI, including using context (Zulkardi et al., 2020)

The stages of formative evaluation that the researcher carried out can be seen in Figure 1. The subject of this study were grade 10 of SMAN 6 Prabumulih in the 2024/2025 academic year.

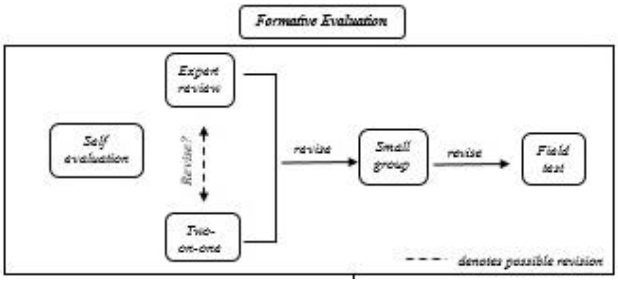

Figure 1. Formative evaluaton stage (Tessmer, 1994).

From figure 1, several steps in formative evaluation can be seen, namely expert review, two on one, small group, field test. This research stage were preliminary and formative evaluation.

At the preliminary stage, researcher began to analyze the curriculum related to the probability material, determine the research subject, research location, validator instruments, interviews, and test. In addition, researcher also designed the material on the probability of mutualy exclusive events. The microlearning media used is inetractive video, utilizing canva and learning apps. Canva is used to design content, while learning apps are used to design interactive videos.

In the formative evaluation stage, researcher carry out a series activies, namely self evaluation, expert review, two on one, small group, and field test. Between each stage, researcher also make a revision, as a follow up reflection on the prototype produced.

At the self evaluation, the researcher design the probability material then re-check that has been designed, the suitability of the material content with the curriculum, characteristics of PMRI, and can help the student's reasoning abilities. The product produced at the self evaluation stage is called prototype 1.

In the expert review, the researcher submit prototype 1 to the content and microlearning media experts. Content experts are mathematics instructors from related institutions. They validated suitability of prototype 1 with the content of probability, and students' reasoning abilites. While media experts are media development experts from seamolec institution. They validated the suitability of the media with the criteria of microlearning media.

Along with the expert review, the researcher tested the prototype 1 on the two students to find out the weakness and strengths of the prototype 1. During the trial, researcher observed the process of students working on worksheet. The researcher also conducted interviews with the two students to find out more about the weakness and strength of the prototype 1.

Based on finding during the previous stages, researcher made revisions to improve prototype 1 until it became a valid prototype 2. It was then tested at the small group stage to see its practically. At the small group stage, prototype 2 was tested on 15 students

divided into 4 groups.

The researcher did the same thing as before, namely conducting observations during the students worked on the worksheet to see the practically of prototype 2. The researcher observed whether prototype 2 could be easily used by students, was interesting to learn, and was effective in helping students understand the concept of probability and helping their reasoning abilities. The description of informaton obtained at this stage will reflect the actual class description, because many students are used as representative of the real class. To find more about this, researcher also conducted interviews with three randomly selected students. Based on the finding in the small groups, the researcher revised the valid prototype 2 to become a valid and practical prototype 3. It was then tested in the field test.

Prototype 3 was tested in the field test stage on 34 grade 10 students, consisting of 12 grops. Each group consists of 3 students, there was one group consisting of 4 students. At this stage, the researcher observed the students' work on the worksheets, to determine the efficiency and effectiveness of the microlearning media integrated into the students' woorksheet on the students' reasoning abilties.

RESULT AND DISCUSSION

In the preliminary stage, researcher produced interactive learning video about compound events and student worksheets that led them to understand the concept of mutually exclusive probability. Interactive video designed to contain compound event matrerial using the context culinary tourism in Prabumulih City. In the vedio section, two questions related to the material presented are inserted. So that in the use of the video, there is student interactivity in answering the available questions, as seen in Figure 2.

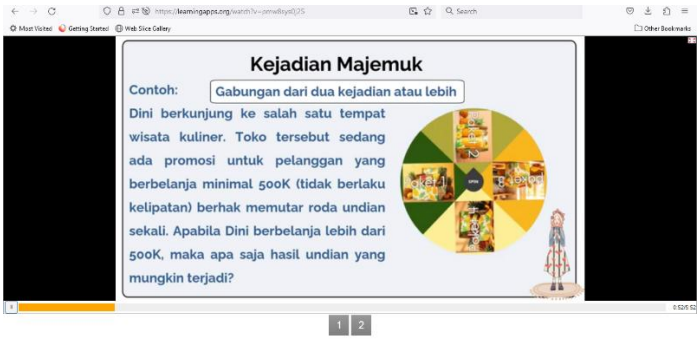

Figure 2. Interactive video display

From figure 2, we can see an interactive video display of compound event material with the context of culinary tourism in Prabumulih City, which has two questions available. This video is about five minutes long, which can be viewed in full at the following link https://learningapps.org/watch?v=pmw8sys0j25.

International Conference on Teaching and Learning Proceeding
Faculty of Education and Teacher Training – Universitas Terbuka
UTCC, South Tangerang, Banten, May 15th 2025
Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

When students have answered the questions given, there will be feedback on the answers given, as seen in Figure 3.

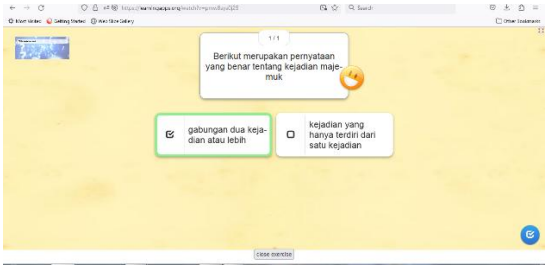

Figure 3. Student answer feedback display

Figure 3 shows a happy emoticon which means the answer given is correct. After that students continue watching the video to see the contents of the material, by selecting the menu at the bottom.

In addition to videos, researcher also designed student worksheets as a space for students discussion and collaboration in understanding the concept of mutually exclusive probability. By understanding the concept, they have indirectly trained their reasoning abilities. The researcher integrated the video link into the student worksheet, as prototype 1, which was then submitted to content and media experts, and tested in two on one stage. Prototype 1 contains an interactive learning video, as microlearning media, and three activites in the worksheet, as a bridge that leads students from informal to formal mathematics. At the end worksheet, practice questions are given.

At the expert review stage, validator comments were generated on prototype 1. Media experts comments that the video was in accordance with the media microlearning category, the discussion focused on the topic, the delivery of material was clear, and the duration was sufficient. Meanwhile content experts commented on the content of video was good enough,in accordance with the learning objectives. The content of student worksheet was also good in accordance with the curriculum and characteristics of PMRI.

Meanwhile, the researcher tested prototype 1 at the two on one stage, as seen Figure 4. This stage has produced student answers and observation result.

Figure 4. Two on one evaluation

Figure 4 shows the students working on prototype 1 individually. While they were

International Conference on Teaching and Learning Proceeding
Faculty of Education and Teacher Training – Universitas Terbuka
UTCC, South Tangerang, Banten, May 15th 2025
Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

working, the researcher conducted observation to determine the difficulties they experienced during work on students worksheet, so that the researcher could determine the weakness and strength of prototype 1.

During the observation the researcher saw that they had difficulty in working on activity 3 number 2 and 3. In activity 3 number 2, they had difficulty determining the members of events A and B, which were in column 4 and 5, as seen in Figure 5.

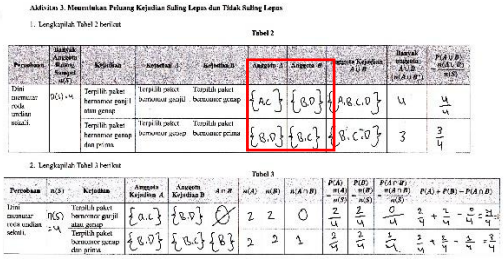

Figure 5. Student answers to activity 3 number 1 and 2

Figure 5 shows students' answer to activity 3, namely determining the probability of mutual exclusive and non-mutual exclusive events. Both tables look for the probability of compound events, students initially had difficulty completing table 3,in columns 4 and 5. After it was explained that both tables had the same experiment and events, students were able to complete the table.

Not only that, the researcher also found that students had difficulty completing activity 3, number 3 and 4, and making conclusion. But after being giving direction, they were able to complete them, as seen in Figure 6.

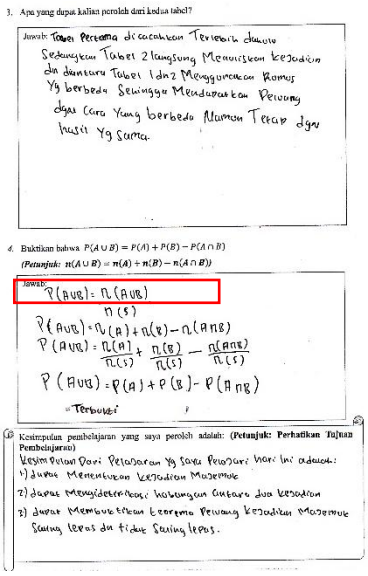

Figure 6. Student answers to activity 3 number 3 and 4

Figure 6 shows the results of one of the students' answers in activity 3. In question number 3, students were asked to write down what they got from the two tables. Initially, students were confused about how to answer it. Finally the researcher asked them to look again the tables, and directed that both tables have the same experiment and events, only the way to determine the probability was different.

The researcher also found that they had difficulty proving the theorem of mutual exclusive and unmutual exclusive probability (see the red box). They should have written the formula for the number of members of a compound event acording to the instruction given. They also had difficulty making their own conclusions, even though the worksheet had been directed to link them to the objectives. However after being drected, they were able to write it down in their own language.

Based on results of observation and interviews, as well as analysis of students' answer to the worksheet, students can basically understand the meaning of the content of the worksheet. It's just that they are not used to solving the mathematical problems using reasoning, so they are confused about constructing their sentences. They usually use formula procedures.

They are also not familiar to proving theorems, and making ther own conclusions. They usually only received ready-to-use formula and cnclude learning by answering provocative questions from theteacher.

From the description above, in general prototype 1 is quite good. The researcher made a slight revision to the second table in activity 3, as seen in Figure 7.

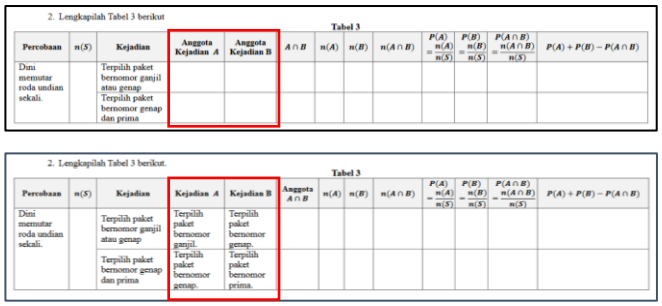

Figure 7 Revisions from prototype 1 to prototype 2

Figure 7 shows the revison of prototype 1 to prototype 2. The researcher made changes by writing down events A and B, so the students not have difficulty distinguishing between them. Thus a valid prototype 2 was produced.

At the small group stage, prototype 2 was tested on 4 groups, as seen Figure 8.

Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

Figure 8. Small group evaluation

Figure 8 shows students working in groups. There are 15 students divided into 4 groups. The researcher observed the process of completing the worksheet to see the effectiveness and efficiency of prototype 2.

Based on results of observations, students were seen to able easily solve the problems given in prototype 2. However they still had to be guided in the proof and conclusion making sections. Through the culinary tourism context provided in the video, student easily imagine all possible outcomes of the lottery wheel experiment, and each activity in the worksheet helps them discover the concept of compound event probability themselves. This is an accordance with the characteristic of PMRI, namely using context and guided reinvention (Putri & Zulkardi, 2020).

Based on researcher's finding during observation and data analysis, it can be said the prototype 2 produced is efficient, as well as effective for training students' reasoning abilities, and it easy to use. There were no change by the researcher, so it can be tested in filed test.

Field test aims the same as small group. It's just that in small group, it is to provide a glimpse of learning in real class. That is why the number of students used reperesents the number of students in real class. In the field test, prototype 2 was tested on 34 students who were divided into 11 groups. Prototype 2 wa taught by a model teacher, as seen Figure 9.

Figure 9. Field test evaluation

International Conference on Teaching and Learning Proceeding
Faculty of Education and Teacher Training – Universitas Terbuka
UTCC, South Tangerang, Banten, May 15th 2025
Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

From figure 9, it can be seen that the model teacher taught final prototype to 34 students in groups. The researcher acted as an observer. During the learning process, students were seen enthusiastic, and active in learning. From the answer given, it was seen that they had been able to estimate all members of the sample space and the probability of compound events. Thus their reasoning abilities began to be trained.

At the end of the learning, partcipants took a test to see the effectiveness of the final prototype produced on students' reasoning abilities. From the results from students' answers, the researcher found errors in the concept, as seen in Figure 10.

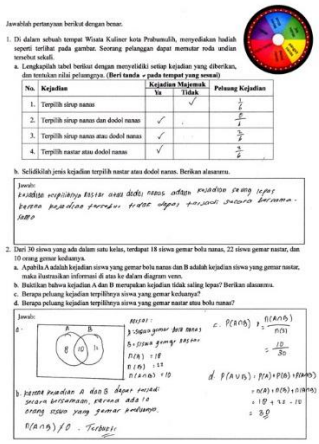

Figure 10. Students' answers ti test questions

Figure 10 is one of the students answers to the test question. From the results given, it can be seen that the student has been able to investigate, prove and determine the mutually exclusive probablity, only there is one mistake in completing the last question (see the red box). It can be seen that the students equates the probability of an events with the number of members of the event. After being confirmed, it turns out that the student just forgot. The overall test results can be seen in table 1.

Table 1. Test Results

Score	Frequency	%	Relative Meaning
86,00 - 100	2	6%	Excellent
71,00 – 85,99	12	35%	Good
50,00 – 70,99	12	35%	Satisfactory
40,00 – 55,99	8	24%	Poor
<40	0	0%	Very Poor

From table 1, it can be seen that 41% students are in the score range of 71 – 100. According to the model teacher, this is very rare, usually only 15% of students are in that range. Based on the results of interviews with several students, it show relevant results, they are very happy with the learning of probability using student worksheet, especially with the shor interactive video (as microlearning media), they can repeat it again until

Vol. 1, No. 1, pg. 388 – 400
ISSN: 3046-594X

they understand the contents of the video. Most student repeat the video up to two times, but some are enough only once.

The findings in this study are microlearning media can help students to learn independently. They can use it by repeating video several times according to their needs. The interactive nature of video makes learning more interesting, so that they can focus more on listening to the contents of the material so that they can answer the question given well. Even if the answer given is wrong, they can find out because there is a feedback after the answer given.

Appropriate context and content can make it easier for students to learn. This material requires students' reasoning abilities in determine the members of the sample space from an experiment, also investigating the types of compound events. So that it indirectly helps train students' reasoning abilities. Through the product that researcher produce, mathematics learning can be made more meaningful and of high quality

CONCLUSION

Based on research results it can be concluded that learning using microlearning media and student worksheet wth a cullinary tourism is more effective in helping students' reasoning ability. This can be seen from the results from students' answers in determining members and investigating the types of compound events, both in students worksheet and test. For further researcher, it is hoped that they can develop microlearning media for advance material.

ACKNOWLEDGEMENT

The authors would like to express our healthfelt thanks to the dedicated of the validators for their assistance, and also to head master, the school administration, model teacher, and observer who have contributed to the success of this study.

REFERENCES

Aldosemani, T. I. (2019). Microlearning for macro-outcomes: students' perceptions of telegram as a microlearning tool. In *Lecture Notes in Educational Technology* (pp. 189–201). Springer International Publishing. https://doi.org/10.1007/978-981-13-7361-9_13

Arican, M., & Kuzu, O. (2020). Diagnosing Preservice Teachers' Understanding of Statistics and Probability: Developing a Test for Cognitive Assessment. *International Journal of Science and Mathematics Education*, *18*(4), 771–790. https://doi.org/10.1007/s10763-019-09985-0

Batanero, C., & Álvarez-Arroyo, R. (2024). Teaching and learning of probability. *ZDM - Mathematics Education*, *56*(1), 5–17. https://doi.org/10.1007/s11858-023-01511-5

BSKAP, K. (2024). *Keputusan kepala badan standar, kurikulum, dan asesmen pendidikan kementerian pendidikan, kebudayaan, riset, dan teknologi Nomor 032/* H/KR/2024 tentang capaian pembelajaran pada pendidikan anak usia dini, jenjang pendidikan dasar, dan jenjang pendidikan menengah pada kurikulum merdeka. In Kemendikbudristek BSKAP RI

Dolasinski, M. J., & Reynolds, J. (2020). Microlearning: A New Learning Model. *Journal of Hospitality and Tourism Research*, *44*(3), 551–561. https://doi.org/10.1177/1096348020901579

Hiltrimartin, C., Hartono, Y., & Indaryanti, I. (2022). *Development of Student Activities in Algebra based on Problem Solving in Middle School*.

Komariyatiningsih, N., Hartono, Y., Doktor, P., Matematika, P., Keguruan, F., Pendidikan, I., Sriwijaya, U., & Selatan Indonesia, S. (n.d.). *Ely Susanti 6) , Duano Sapta Nusantara 7) 1) Sekolah Menengah Atas Negeri 6 Prabumulih*. http://jurnal.radenfatah.ac.id/index.php/jpmrafa

Konold, C., Pollatsek, A., Well, A., Lohmeier, J., & Lipson, A. (1993). Inconsistencies in Students' Reasoning about Probability. In *Source: Journal for Research in Mathematics Education* (Vol. 24, Issue 5). http://www.jstor.orgURL:http://www.jstor.org/stable/749150http://www.jstor.org/stable/749150?seq=1&cid=pdf-reference#references_tab_contents

Malalina, Indra Putri, R. I., Zulkardi, & Hartono, Y. (2024). Developing mathematics teaching materials using maritime context for higher-order thinking in junior high school. In *Journal on Mathematics Education* (Vol. 15, Issue 1, pp. 173–190). Sriwijaya University. https://doi.org/10.22342/jme.v15i1.pp173-190

McNeill, L., & Fitch, D. (2023). Microlearning through the Lens of Gagne's Nine Events of Instruction: A Qualitative Study. *TechTrends*, *67*(3), 521–533. https://doi.org/10.1007/s11528-022-00805-x

Putri, D. S., Hiltrimartin, C., Hartono, Y., & Indaryanti, I. (2022). *Development of Student Activity Sheets for System of Linear Equation Two Variables Based on Problem Solving in Junior High School*.

Putri, R. I. I., & Zulkardi. (2020). Designing piSA-like mathematics task using Asian games context. *Journal on Mathematics Education*, *11*(1), 135–144. https://doi.org/10.22342/jme.11.1.9786.135-144

Suparti Kurnianingsih, R., Ilma Indra Putri, R., & Hartono, Y. (2023). *Teaching Probability using Snakes and Ladders Games in Middle School*. 194–198. https://doi.org/10.5220/0009995000002499

Tessmer, M. (1994). Formative evaluation alternative formative tessmer. *Performance Improvement Quarterly*, *7*(1), 3-18.https://doi.org/10.1111/j.1937-8327.1994.tb00613.x

Vásquez, C., García-alonso, I., Seckel, M. J., & Alsina, Á. (2021). Education for sustainable development in primary education textbooks—an educational approach from statistical and probabilistic literacy. *Sustainability (Switzerland)*, *13*(6). https://doi.org/10.3390/su13063115

Zulkardi, Z., Putri, R.I.I., & Wijaya, A. (2020). Two decades of realistic mathematics education in Indonesia. *Internasional reflecttions on the Netherlands didactics of mathematics: Visions on and experiences with Realistic Mathematics Education*, 325 – 340. https://doi.org/10.1007/978-3-030-20223-1_18