Asia Research Network Journal of Education
Vol. 6, No. 1, pp. 1-12, Jan. – Apr. 2026

Integrating Contextualized Writing Activities in Lessons on Probability

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Received: 16 Jun 2025 Revised: 22 Feb 2026 Accepted: 24 Feb 2026

Abstract. Contextualized writing activities involve the use of real-life situations that enable students to articulate their problem-solving processes through writing, thereby strengthening both their mathematical and writing abilities. This study aimed to create probability lesson plans incorporating such contextualized writing activities for Grade 10 students. The researcher employed the Research and Development (R&D) model by Borg and Gall (2003), as cited by Gustiani (2019), to guide the development and validation of the lesson plans. Three content experts evaluated the lesson plans on a 4-point Likert scale, with each rating level—Excellent, Satisfactory, Below Satisfactory, and Poor—determined by the completeness, clarity, alignment with learning objectives, and relevance of activities. Expert feedback was used to refine and improve the final lesson plans. A total of three lesson plans were crafted using a backward curriculum design approach, aligned with the K to 12 curriculum standards, and infused with contextualized writing activities. Three content experts evaluated the lesson plans, rating them as "Excellent" in terms of structure, contextual relevance, and practical application. Their feedback highlighted two main strengths: (1) the lessons' strong alignment with learning competencies/objectives, and (2) the effective use of culturally relevant, real-life images and scenarios within the lessons. These insights and recommendations were incorporated into the final revision of the lesson plans.

Keywords: Contextualization, Contextualized Writing Activities, Writing in Math

1. Introduction

In recent years, there have been persistent challenges to teaching and learning mathematics. Several studies also revealed that the learners often struggle in linking math concepts and organizing ideas to solve problems, as cited by Gallard et al. (2010). The future problems that the students will face require them to draw solutions from an interdisciplinary point of view. Learners need a more in-depth understanding of issues rather than rote memorization of facts, and this is very true at present when information is literally at our fingertips (Jackaria, Buan, and Yuenyong, 2019). Hence, learners are expected not just to memorize mathematical facts and procedures but to explain and justify their thoughts orally, in writing, and using other forms of media. However, low achievement in numeracy, reading, and writing is still the perennial problem in most schools. Many learners have difficulties in understanding mathematics, especially when

written in words (Alt, Arizmendi, and Beal, 2014). On the other hand, some may find reading easy but have difficulties in making sense of numbers. French (2013) stressed that those learners who failed to attain fluency in these areas are likely to find difficulties learning in succeeding years.

Hence, the study of integrating contextualized writing activities in mathematics is one way to bridge the gap between the teaching and learning process inside the classroom. Kuzle (2013) mentioned that "writing in mathematics can also help students consolidate their thinking because it requires them to reflect on their work and clarify their thoughts about the mathematical ideas. On the other hand, Chiappetta (2009) studied the integration of mathematics with other subjects, reporting its positive benefits for the problem solver: it makes it meaningful for the students and makes them appreciate the importance of math in the real world. However, mathematics is often integrated with sciences as cited in Kurt & Pehlivan (2013) but not with reading and writing, which are fundamental skills any student should master. Therefore, finding a better way of successfully integrating both skills is crucial and beneficial to pupils' academic success, as observed in the study of Jackaria et al. (2019).

One way to create this relationship is through contextualization, or the teaching of basic skills in the context of disciplinary topic areas. In the study of Klein & Samuels (2010), the results showed that contextualized learning activities by teaching the lesson in the real-life context significantly increased the learning of students as well as motivated the learners to know, understand, and appreciate cultural heritage (Center for Occupational Research and Development, 2012 and Bringas, 2014). On the contrary, contextualized writing activities are not commonly practiced by teachers.

Of the different topics in mathematics, there have been consistent findings from a number of studies suggesting that the learners have a problem in conceptual understanding concerning probability. Many research studies as cited in Brown et al. (2007) indicated that formal mathematical presentations without having gone through sufficient real-life situations in normal mathematics class were not enough to support students in learning probability clearly. This is further evidenced in the study of PISA 2018, where Filipino learners scored considerably low in mathematics literacy (Trinidad, 2020).

With this long-standing problem in probability education, this paper focuses on developing lesson plans that incorporate contextualized writing activities into probability lessons to improve learners' conceptual understanding and ability to apply mathematics in real-world situations. The study is guided by a conceptual framework that connects mathematics learning to writing and real-life contextualization: writing activities promote reflection and clarification of mathematical thinking (Kuzle, 2013), whereas placing problems in meaningful contexts promotes deeper understanding and practical application. This framework views contextualized writing as a link between abstract mathematical concepts and practical problem-solving abilities. Despite the potential benefits, learners continue to struggle with conceptual understanding of probability, especially when attempting to connect abstract concepts to real-world applications. The lack of integration of writing and contextualized activities in mathematics classrooms contributes to the ongoing issue.

Thus, the purpose of this research is to create and incorporate writing prompts into probability lessons that are contextualized in real-world situations. These prompts are intended to encourage students to explain and justify their reasoning, reflect on their problem-solving strategies, and relate mathematical concepts to real-world applications. By embedding these writing activities in lessons, students can consolidate their understanding, engage more meaningfully with mathematical ideas, and develop skills that extend beyond rote memorization.

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2. Methodology

This study used Borg and Gall's (2003) Research and Development (R&D) method to develop and validate educational lessons (Gustiani, 2019). Using this approach, probability lesson plans with contextualized writing activities were created. This research design is still relevant and timely in contemporary educational studies, particularly the incorporation of contextualized tasks and active learning strategies.

2.1 Respondents and Sampling

The respondents were chosen through purposive sampling. The selection criteria included the learners' preferred learning modalities as well as the availability of devices for online class discussions. The respondents were Grade 10 students at a secondary school in Balo-i who preferred blended learning as a method of instruction.

2.2 Development of Lesson Plans and Achievement Test

In the development phase, the researcher gathered information and researched the topic of the lesson plans with contextualized writing activities based on the K-12 Mathematics Curriculum Guide—Most Essential Learning Competencies (MELCs). Probability was chosen as the topic. The researcher then developed lesson plans in probability with contextualized writing activities in mathematics. For the development of the achievement test, the table of specifications was first created to ensure its content validity. Then, most test questions were adapted from the Department of Education – Learning Resources Management and Development System (LRMDS), which the researcher then modified.

2.3 Expert Evaluation and Rating

The developed lesson plans were then evaluated by the content experts using a rating scale. The content experts also gave their comments and suggestions for further improvement of the lesson. The ratings, as well as the comments and suggestions from the content experts, are then consolidated and coded.

Table 1. Interpreting the Ratings of Content Experts on the Probability Lesson Plans.

Mean Range	Interpretation	Description
3.51 - 4.00	Excellent	The lesson plan is extremely comprehensive, clear, and well-structured; the objectives are in line with the MELCs; the activities are engaging, contextually relevant, and facilitate reasoning and problem-solving; and the instructions and assessment items are clear and effective.
2.51 - 3.50	Satisfactory	The lesson plan is complete and mostly clear; the objectives are aligned; the activities are relevant and engaging; minor improvements are required in clarity, sequencing, and assessment.
1.51 - 2.50	Below Satisfactory	The lesson plan is only partially completed; some objectives are unclear or misaligned; activities are insufficiently engaging or lack contextual relevance; and significant improvements in structure, clarity, and assessment are required.
1.00 - 1.50	Poor	The lesson plan is incomplete, unclear, or poorly structured; objectives are missing or misaligned; activities are inappropriate or ineffective; and assessments do not capture intended outcomes.

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In interpreting the average ratings given by the content experts on the probability lesson plans using a 4-point Likert scale, the determination of the range of mean values was based on the assumption that the evaluator's average responses fall within an interval rather than the four distinct values. This was also based on the suggestion of the statisticians. Table 1 shows the scaling of the means and their corresponding interpretation and description as used in this study.

2.4 Incorporation of Expert Feedback

The lesson plans were revised based on feedback and suggestions from content experts. The final lesson plans show improvements in clarity, completeness, alignment with MELCs, and assessment quality, indicating that they meet the standards for high-quality mathematics instruction.

3. Results and Discussion

3.1 Development of Lesson Plans and Writing Prompts

Development is the process of translating design specifications into the physical form (Seels and Richey, 2012). According to this definition, development is defined as the process of making a product that has certain specifications into a real physical form. Educational research and development is a process used to develop and validate educational products, meaning educational development research (R&D). The results of development research are not only the development of an existing product but also finding knowledge or answers to practical problems (Borg and Gall, 2003).

The development model used is the Research and Development (R & D) model by Borg and Gall (2003). The steps are as follows:



Figure 1. Percentage of students with correct responses

3.1.1 Research and Information Collecting.

This first step includes a needs assessment, literature review, and research. The literature review was conducted as a temporary introduction to the product to be developed, with the goal of gathering research findings and other information relevant to planned product development. The research was conducted so that the researchers could learn a variety of information about the product that would be developed.

From the Philippine Informal Reading Inventory (Phil-IRI) data obtained from the research setting of the study for S.Y. (2020–2021) and S.Y. (2021-2022), it was revealed that the learners need to undergo reading and writing enrichment. According to the Phil-IRI school coordinator, teachers must apply one-on-one reading and seriously facilitate the non-reader to transform them into a reader while simultaneously exposing them to writing activities.

The Phil-IRI results show that in both school years, a lot of learners are at the frustration level. The following reasons are evident why these happened: parents or adults are not available to help the learner read; the inability of learners to comprehend is due to fewer

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exposures to writing activities; the accessibility of multimedia gadgets distracts the attention of learners; and absenteeism.

Based on the data gathered from the research setting during the home visitation conducted by the teachers, P1 shared that learners have a low score in the given modules because of their context. P2 also added that teachers must provide an activity that is contextualized for them to easily understand the tasks.

3.1.2 Planning.

After gathering comprehensive information and data on the existing problems, the researcher began to plan how to address the learners' existing problems in the research setting. The goal of this study was to create and implement probability lesson plans that included contextualized writing activities in mathematics.

3.1.3 Develop a Preliminary Form of Lesson.

The development of lesson plans follows the backward curriculum design as a curriculum design popularized by Grant Wiggins and Jay McTighe in 1998. The basic rationale for choosing a backward curriculum design is that it ensures the development of the desired output (i.e., the development and integration of writing activities). According to Jay McTighe and Grant Wiggins (1998), as cited in Sample (2011), backward design follows three stages; these are 1.) Identify the desired result, 2.) Determine assessment evidence, and 3.) Plan learning experiences and instruction.

Figure 2 shows the process of developing the probability lesson plans with contextualized writing activities. Following the Backward Curriculum Design, the researcher first identified the learning objectives from the most essential learning competencies of the K to 12 Curriculum Standards. Next, assessment tools were developed, and the development of the lesson plans included the contextualizing of writing activities. After developing the lesson plans, they were subjected to validation for approval. Afterward, the lesson plans underwent tryouts and revisions. Making reflection is part of every step in the development process.

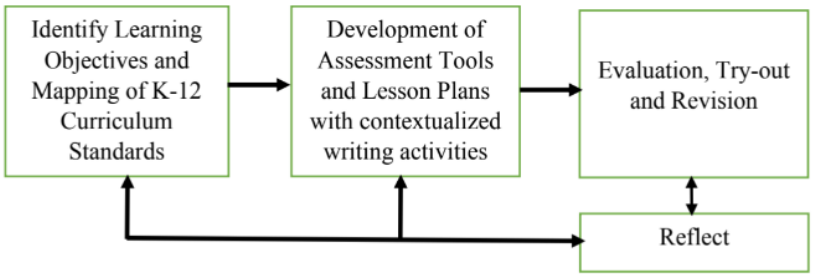


Figure 2. Process of Development of Lesson Plans and Activities

The learning objectives were crafted from the Most Essential Learning Competencies (MELCs) of the K to 12 Mathematics Curriculum Guide to ensure that the total learning was compliant with the educational goals of the Department of Education. Table 2 shows the learning objectives used for the development of lesson plans in this study.

Table 2. Learning Objectives Crafted Based on the MELCs

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Content	Content Standards	Performance Standards	Most Essential Learning Competencies	Learning Objectives
Statistics	The learner demonstrates understanding of key concepts of combinatorics and probability.	The learner will be able to use precise counting techniques and probability in formulating conclusions and making decisions.	solves problems involving probability.	- Illustrate dependent events, independent events, and conditional probability; - Solve problems involving the probability of independent and dependent events; - Solve problems on conditional probability of dependent and independent events; and - Appreciate the concept of independent and dependent events and conditional probability in real life.

Note: Adapted from DepEd, K-12 CG-MELCs

After identifying the learning objectives, assessment tools and lesson plans were developed. The assessment tool used to investigate the learners' conceptual understanding was the achievement test. The assessment tools used to evaluate the lesson plans were the lesson rating scales. A rating scale is an instrument used by the content experts to rate the lessons in terms of organization, contextualization, and usefulness. The 20-item multiple-choice Achievement Test was used to assess the learners' conceptual understanding through the implementation of probability lesson plans with contextualized writing activities.

The researcher started by searching literature on different math writing activities that can be applied in the context of the study. Initially, the plan was to implement writing activities using the six (6) language strategies (taxonomy building, composing with keywords, metacognition, defining the format for clarity, profiles and frames, and using reasons, procedures, and results). These are the Write-to-Explain Activities where learners are asked to explain and justify answers rather than just do calculations. However, considering the time and learners' experiences with the writing math activities, this study was limited to utilizing one language strategy in the contextualized writing activities.

The next step was the construction of appropriate writing prompts to help learners in organizing their writing activities. The researcher recognized the importance of guiding the learners using writing prompts, especially in the discussion part of the utilization of lesson plans. It was also decided that the writing prompts will eventually be removed from the activity as soon as the learners have developed their writing and math skills. This is based on Vygotsky's ideas of Zone of Proximal Development (ZPD) and scaffolding, where the quality and quantity of assistance need to change over time, with the learner assuming more responsibility (Thompson, 2013).

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There were two writing prompts used in the lessons. They are as follows:
1. Metacognition statement for representation.
Sample prompts:
▪ I know how to represent data ...
▪ I begin by ...
▪ After that ...
▪ Then ...
▪ Finally ...
2. Metacognition statement for explanation.
Sample prompts:
▪ I can explain how to solve ...
▪ I can explain the difference between ...
▪ I can explain the steps for solving mathematical problem by ...

Aside from the integration of the writing activities, the story problems used in the developed lesson plans were contextualized by relating it to the local setting. This is based on their idea that learners learn better mathematical concepts by working with things of their culture and the language they are familiar with (Hafiz & Farik, 2016; Njoroge, 2017).

Figure 3 shows the sample developed writing math activity used in the study. This particular activity is from lesson 1 activity 1. The story problem is about the kandori of Norjana, who received Malong, a landap with different colors. A malong a landap is unique tubular clothing of the Maranao tribe that is usually worn by the tribe's royalty or elite people in Lanao. Each landap is a symbol of royalty and value in the Maranao society. In the past, only Datu's and Ba-e's (kings and queens) families and selected members of the society were able to wear them. The learners were asked to explain how to solve problems involving dependent probabilities.

The lesson plan model used in this study is based on the DepEd SDO Lanao del Norte Daily Lesson Plan (DLP) template for Grade 10 mathematics, which consists of (I) Objectives, (II) Content, (III) Learning Resources, (IV) Procedures, (V) Remarks, and (VI) Reflection. See appendix E for the DLP template.

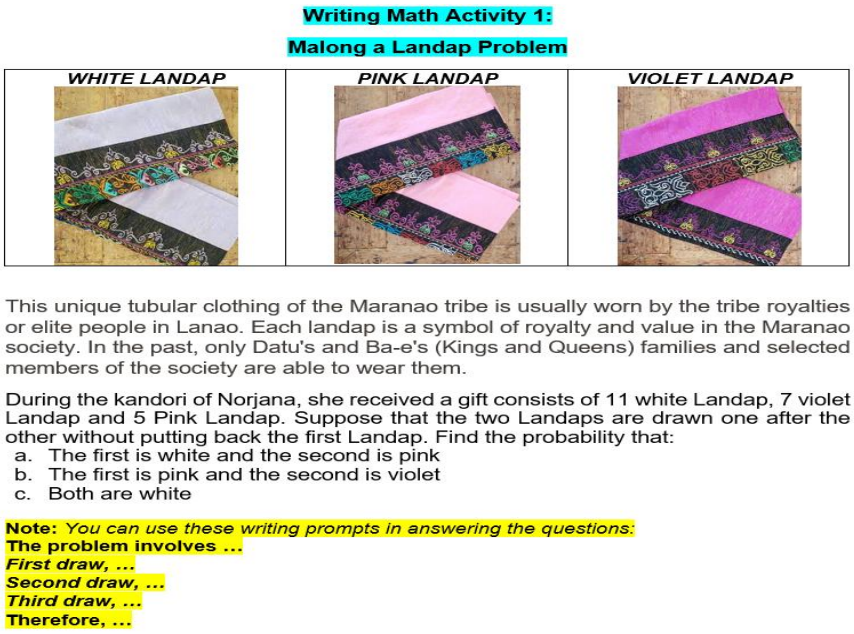


Figure 3. Sample Developed Writing Math Activity

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The unique features of the developed lesson plans are the integration of writing and math activities. The lesson plans have write-to-explain math activities where learners are asked not only to compute but also to explain and justify their answers in writing. Each lesson plan is expected to be taught in one day. The story problems are contextualized. Three lesson plans were developed by the researcher covering problem-solving involving dependent events, independent events, and the conditional probability of dependent and independent events. These topics were selected from the Most Essential Learning Competencies (MELCs) of the K to 12 Mathematics Curriculum Guide based on the researcher's expected time frame of the actual utilization.

3.1.4 Expert Validation.

The next step was the evaluation of lesson plans. The developed lesson plans with contextualized writing activities were evaluated by the three content experts using the lesson rating scale, eliciting both numerical data and qualitative comments. Using the evaluation tool, the lesson plans were evaluated and passed all the indicators of the three (3) categories: organization, contextualization, and usefulness.

Table 3. Summary of Ratings of the Content Experts on the Developed Lesson Plans

CATEGORY	DLP 1	DLP 2	DLP 3	Overall
Organization	3.67 E	3.67 E	3.67 E	3.67 E
Contextualization	3.92 E	3.92 E	3.75 E	3.86 E
Usefulness	3.78 E	3.78 E	3.78 E	3.78 E
Mean	3.79 E	3.79 E	3.73 E	3.77 E
Description	Excellent	Excellent	Excellent	Excellent

Using the Evaluation Rating Scale, the developed lesson plans were evaluated and passed all three (3) categories, including the organization, contextualization, and usefulness to other teachers as excellent, satisfactory, less satisfactory, and poor. Table 3 shows the summary of the ratings of the content experts.

Based on the computed mean scores, three (3) lesson plans were given an 'Excellent' rating by the content experts. These are lesson plan 1 (M = 3.79, SD = 0.31), lesson plan 2 (M = 3.79, SD = 0.31), and lesson plan 3 (M = 3.73, SD = 0.36).

Overall, the panel of evaluators gave the developed lessons integrating writing and math activities an "Excellent" rating (M = 3.77, SD = 0.32) as to their organization, contextualization, and usefulness. Among the different categories, the three content experts rated the contextualization aspect of the lesson plans highest, signifying that the probability lesson plans are well-structured and coherent with the culture of the local setting. With this, the learners are able to connect with the activities employed.

3.1.5 Lesson Revision.

The developed lesson plans underwent revisions based on the results of the content experts, composed of three math educators. Although the developed lesson plans were given an 'Excellent' rating, math educators who evaluated the lesson plans gave some suggestions. These suggestions were taken into account by the researcher in order to improve the developed lesson plans with contextualized writing activities for the utilization phase. The evaluators' comments focused on the learning competencies/objectives part of the lesson plan.

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Table 4. Revision on Learning Competencies/Objectives in Lesson Plan 1

Before	Revised
C. Learning Competencies/Objectives (Write the code for each LC)	C. Learning Competencies/Objectives (Write the code for each LC)
Most Essential Learning Competency (MELC):	Most Essential Learning Competency (MELC):
The learner solves problems involving probability. M10SP-IIIi-1	*The learner solves problems involving probability.* M10SP-IIIi-4
	Learning Objectives: 1. Illustrate dependent events; 2. Solve problems involving the probability of dependent events; 3. Appreciate the concept of dependent events in real life.

Table 4 shows the revision made to lesson plan 1. The comment was to provide achievable objectives aside from the learning competency provided. Hence, to comply with the comments provided by the content experts, the researcher provided three (3) achievable learning objectives aligned with the given Most Essential Learning Competency (MELC). It is important that the lesson objectives utilized in this study align with the MELC, and it is achievable because this would determine whether the learners grasp the topic or they have attained the target learning objectives set all through the developed lesson plan. With this, the researcher emphasized the three keywords that must be met at the end of the lesson, which are to illustrate, solve, and appreciate.

Other evaluators commented on the use of the actual picture's context in the story. Table 5 shows the revision of the picture of activity 1 in lesson plan 2. One evaluator wrote, "Provide a picture of Malong and Landap so that learners can be connected to the story." The idea of relating the lesson to learners' cultural context was found effective in the studies of Natinga (2015) and Aninon (2006).

Table 5. Revision on Activity 1 of Lesson plan 2

Before	After
This unique tubular clothing of the Maranao tribe is usually worn by the tribe's royalty or elite people in Lanao. Each landap is a symbol of royalty and value in the Maranao society. In the past, only Datu's and Ba-e's (Kings and Queens) families and selected members of the society are able to wear them.	*Malong a Landap Problem* *White Landap* *Pink Landap* *Violet Landap*  This unique tubular clothing of the Maranao tribe is usually worn by the tribe's royalty or elite people in Lanao. Each landap is a symbol of royalty and value in the Maranao society. In the past, only Datu's and Ba-e's (Kings and Queens) families and selected members of the society are able to wear them.

3.1.5 Operational Field Testing: Try-out Phase.

The tryout aimed to determine the appropriateness of the developed lesson plan and writing math activities for possible improvement and the length of time of implementation

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of each lesson plan, considering that the learners are now faced with the writing math activities.

The implementation of the try-out phase lasted for five (5) days, which also included the distribution of the achievement test (pre-test and post-test), utilization of the developed probability lesson plans with contextualized writing activities through online classes, and a perception questionnaire. It also looked into learners' difficulties with the writing math activities. It was also during this tryout that the pretest was also item analyzed in the actual classroom.

However, during the implementation process, further improvements were noted. (1) The researcher must extend the allotted time for the writing activities. Instead of three minutes, the learners must be given five minutes to answer each activity. (2) The researcher must provide a scoring guide for the writing activities. Instead of showing the score guide once during the discussion, the score guide must be presented before doing the writing activity. (3) Before the administration of the writing activity, the researcher must apply writing prompts in the discussion. Most learners in the grade 10 level are still not familiar with how to start their writing in explaining their answers.

Table 6. T-test Result during the Try-out Phase on Learners' Achievement Test

Pre-test		**Post-test**			**Mean Difference**	**SD**	**p**	**t**	**df**
M	SD	M	SD	N	-5.80	2.69	.000	-11.78*	29
5.30	1.99	11.10	3.16	30					

**significant at $\alpha = 0.05$ level*

As shown in Table 6, the paired-samples t-test was conducted to compare learners' achievement test (pre-test and post-test scores) during the try-out phase. There was a significant difference in the scores for the pre-test (M = 5.30, SD = 1.99) and post-test (M=11.10, SD=3.16) ; t (29) = -11.78, p = .000. This suggests that there is a positive increase in the learners' conceptual understanding of probability from the achievement test. Furthermore, the result indicates that the conceptual understanding of the learners has initially improved. It was also during this tryout that the pretest was also analyzed in the actual classroom. This try-out phase result, however, is only a basis used to further improve the developed lessons and implementation process during final utilization.

3.1.6 Operational Lesson Revision.

The researcher used feedback from the try-out phase to revise the probability lesson plans with contextualized writing activities in mathematics and improve the implementation process during final use. The initial results from the tryout phase served as the foundation for the improvements and revisions made during the final utilization.

4. Conclusion and Recommendations

The development of probability lesson plans integrating contextualized writing activities follows a backward curriculum design. Based on the suggestions of the panel of evaluators, simplicity of language and the use of local context should be considered in constructing math story problems. The panel of evaluators rated the developed lessons as 'Excellent,' indicating the appropriateness and usability of the developed lessons integrating writing and math using the metacognition statement prompts.

The use of writing prompts in the story problems made it easier for the learners to understand the problem and write their ideas; therefore, teachers may contextualize math problems and activities to make them more interesting to learners.

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