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Designing Snack-Based PMRI Problems to Support Elementary Students' Understanding of Weight Measurement

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Abstract

Snacks, which are frequently encountered by elementary school students in their everyday lives, offer a meaningful context for learning about weight measurement. This study aims to design and develop weight measurement problems within the framework of the Indonesian Realistic Mathematics Education known as PMRI approach, with the goal of producing snack-based contextual tasks that are valid, practical, and instructionally effective. The research adopted a development-oriented design research methodology comprising two main phases: a preliminary phase and a formative evaluation phase. Participants included three students in the one-to-one stage, six students in the small-group stage, and seventeen students in the field test stage. Data were collected through document analysis, walkthroughs, classroom observations, interviews, and written assessments. The study yielded ten validated snack-based weight measurement problems for use in elementary mathematics classrooms. These products can support teachers in implementing contextual instruction on weight measurement and provide a basis for future research on the development of student worksheets grounded in contextual learning.

Keywords: context; PMRI; question development; snacks; weight measurement

Introduction

The Indonesian national curriculum has undergone ten reforms between 1947 and 2013 (Asri, 2017). The most recent, the 2013 Curriculum, remains in use and emphasizes student activity and participation in learning. In elementary schools, this curriculum adopts a thematic structure in which each theme comprises several sub-themes that integrate multiple subjects, with the exception of religion, while in the upper grades some subjects, such as Physical Education and Mathematics, are also taught as separate disciplines within the thematic framework.

Mathematics is a crucial subject for human life, playing a pervasive role across many domains, including in contemporary technological and digital contexts (Siregar, 2017). In Indonesia, however, students' mathematical performance remains low; data from the Programme for International Student Assessment (PISA) administered by the Organisation for Economic Co-operation and Development (OECD) indicate that Indonesia ranked 72nd out of 78 participating countries in 2018, with an average mathematics score of 373 (Kemendikbud, 2019). Consistent with this, results from the Indonesia National Assessment Program (INAP) show that, among Grade 4 elementary students, only 2.29% achieved a good level, 20.58% reached a sufficient level, and 77.13% were categorized as less proficient in mathematics (Nanus, 2020). These findings suggest that many students experience substantial difficulties in learning mathematics (Yeni, 2015).

Several factors contribute to students' difficulties in learning mathematics, including limited interest and motivation, insufficient support from parents and the surrounding environment, and the use of instructional approaches that are not well aligned with students' needs (Yeni, 2015). Teachers play a central role in shaping students' mathematical understanding and therefore need to design and implement appropriate instructional approaches so that learning goals can be achieved. One such approach is the Indonesian Realistic Mathematics Education known as PMRI approach, which can be integrated into classroom practice to support student learning (Izzabella, 2017). In addition, teachers are expected to be able to develop mathematical problems that students can interpret and solve accurately, particularly contextual problems that may foster students' mathematical thinking.

PMRI is an instructional approach that uses real-life situations as the starting point for learning activities, thereby supporting students in understanding mathematical ideas and solving problems that are meaningful in their everyday lives (Basu, 2021; Oftiani & Abdul, 2017). Within this approach, mathematics lessons are explicitly connected to daily experiences so that students can develop problem-solving skills in mathematics (Cahirati et al., 2020; Muchlis, 2012). Problem solving in such meaningful contexts can encourage students to think more critically and to deepen their mathematical problem-solving abilities (Gusnia et al., 2023). In particular, solving problems related to weight in everyday situations can become more accessible for students when such problems are designed using the PMRI approach with an appropriate context.

Context is a key characteristic of the PMRI approach in mathematics learning (Purwasi, 2025; Lisnani et al., 2025; Utari et al., 2015). The contexts used are drawn from students' real-life experiences, one of which is the use of snacks. Snacks are suitable as a learning context because students frequently purchase them and they are readily available in school canteens, food stalls, and shopping centers; examples include wafers, donuts, and chocolate, among others (Putri et al., 2025; Muhtadi, 2025; Fayzahra, 2025; Hardini, 2021). Such contexts are important in problem development because they can stimulate students' thinking and challenge them to be more creative in solving mathematical problems (Sari et al., 2022).

Because the PMRI approach relies on meaningful contexts, the problems posed to students are also designed around contextual situations, such as snacks (Nuraida & Putri, 2020). Contextual problems can help students situate mathematical ideas in familiar situations, thereby supporting them in answering questions and engaging in more sophisticated mathematical thinking (Saputri & Zulkardi, 2020; Putra et al., 2016). In this study on the development of problems using snack contexts, the research was conducted in one state elementary school in Palembang, Indonesia. Classroom observations indicated that the PMRI approach had not previously been implemented in this school. Furthermore, interviews with the Grade 2 homeroom teacher revealed that students still experienced difficulties in understanding the material on weight measurement, which was attributed in part to the limited development of problems by the teacher and, consequently, to students' difficulties in interpreting the questions posed.

The use of problems situated in snack contexts is expected to render mathematics learning more meaningful and to enhance students' understanding when solving problems related to weight in everyday life (Lisnani et al., 2020; Mangelep & Derel, 2018). Snack-based contextual problems for teaching weight measurement within a PMRI framework have received relatively little attention in previous research; most studies have employed other types of contexts when addressing weight measurement (Sakiman et al., 2023). This indicates that the focus on snack contexts, particularly in relation to weight measurement, represents a novelty in the present study. Accordingly, this study aims to develop weight measurement problems using the PMRI approach in the context of snacks that meet the criteria of validity, practicality, and effectiveness.

Methods

The research employed a development-oriented design research methodology with the objective of producing valid weight measurement problems grounded in the PMRI approach within a food context. The process comprised two main phases: a preliminary phase (preparation) and a formative evaluation phase that included self-evaluation, expert review, one-to-one trials, small group trials, and field testing (Mangelep, 2018). Figure 1 presents the overall research and development flow framework.

Figure 1 depicts the research development flow, which consists of the preliminary phase and the formative evaluation phase. The preliminary phase comprises a preparation stage and a design stage. In the preparation stage, the need to develop snack-based problems for classroom teachers was analyzed, alongside a review of the curriculum implemented in the learning process. In the design stage, a test blueprint, problem sheets, and scoring guidelines were constructed. The initial problems were adapted from the Grade 2 student textbook for Theme 6, and ten PMRI-oriented questions using snack contexts were generated. These questions employed snack food contexts such as biscuits, cassava chips, potato chips, wafers, and chocolate.

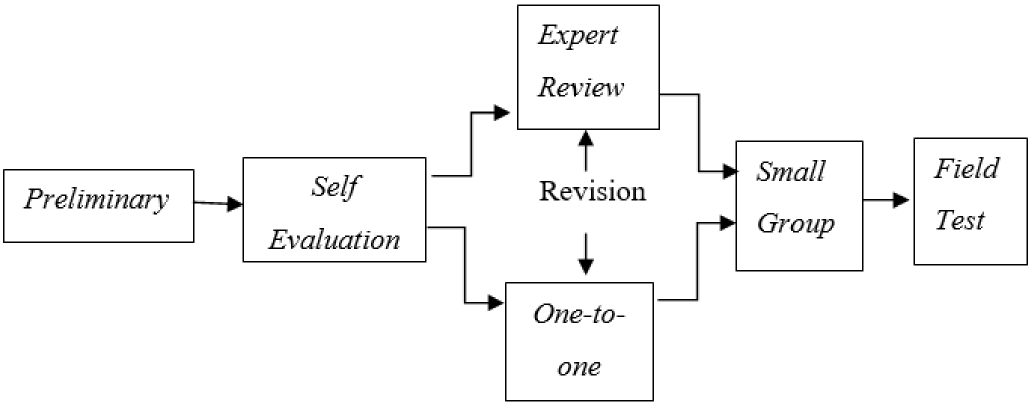

Figure 1 Research development flow framework

In the preparation stage, a review of relevant literature was conducted and the characteristics of students and the curriculum were analyzed. The study was carried out in one school, State Elementary School 04 Talang Kelapa. The researcher visited the school to identify participants for the one-to-one phase, selecting three students representing high, medium, and low mathematics achievement levels. Subsequently, six students participated in the small group phase and seventeen students in the field test phase. During the design stage, the test blueprint, question sheets, and scoring rubrics were finalized, drawing on the Grade 2 student textbook for Theme 6 as the primary source. At this stage, ten questions using snack contexts were produced.

The formative evaluation phase consisted of self-evaluation, expert review, one-to-one trials, small group trials, and a field test. During the self-evaluation stage, the snack-based weight measurement problems were examined by the researcher for content accuracy, construct quality, and linguistic clarity. At this point, the researcher also consulted with a supervisor regarding the quality and appropriateness of the problems. Any typographical, wording, or formulation issues were revised prior to proceeding to the subsequent stages.

The participants in this study were second-grade students at State Elementary School 04 Talang Kelapa. The sample comprised three students in the one-to-one phase, six students in the small group phase, and seventeen students in the field test phase. The decision to involve three students in the one-to-one phase and six students in the small group phase followed procedures adopted in previous research by Mangelep (2018).

Data collection techniques included document analysis, walkthroughs, observations, interviews, and tests. The documents consisted of the 2013 Curriculum and the Grade 2 thematic textbook for Theme 6, including weight measurement test sheets (Astuti & Fransiska, 2013). These documents informed subsequent stages of problem development, test blueprints, and scoring schemes. Experts in relevant fields were directly involved during the prototype and expert review stages to provide validation and consultation, while students contributed feedback during testing and validation. Observations were conducted through video recordings of students working on the test and through open interviews to capture students' solution processes and difficulties. In addition, interviews with the Grade 2 homeroom teacher were conducted to obtain pedagogical insights on weight measurement and to identify students representing high, medium, and low achievement levels for participation in the one-to-one phase. Test administration during the field test phase was used to evaluate the effectiveness (potential effects) of the items on students' mathematical performance. Data analysis procedures included document analysis, walkthrough analysis, observation and interview analysis, and test analysis.

Results and Discussion

The Preliminary Stage

In the curriculum analysis stage, learning materials were identified based on the curriculum implemented at State Elementary School 04 Talang Kelapa. The school uses the 2013 Curriculum, with the relevant core competencies for this study taught in Grade 2 and supported by the student textbook for Theme 6, "Caring for Animals and Plants."

At the design stage, a test blueprint, problem sheets, and scoring guidelines were constructed. The initial problems were adapted from the Grade 2 student textbook for Theme 6, and ten items were developed using snack contexts. These items drew on everyday snack foods such as biscuits, cassava chips, potato chips, wafers, and chocolate, and are summarized in Table 1.

Table 1. Question items at the design stage

Question units	Question
1	Read the following story questions, then fill in the blanks correctly!  On Monday, Doni and his mother went to the supermarket. Doni bought 3 snacks in the form of jam biscuits, each biscuit weighs 150 grams, so 3 biscuits weight … grams. Then on Tuesday, Doni and his brother went to the supermarket again. Doni bought 2 more biscuits weighing 300 grams. So, the weight of the biscuits that Doni had from Monday to Tuesday was … grams.
2	Reni went to the supermarket to buy 150 grams of biscuit snacks. However, Reni still needed two other snacks to give to Lani. These two snacks are ... a) Cassava chips, 70 grams, and

b) Potatoes, 50 grams.
Circle the snacks according to their weight ...

a)


A B

b)


A B

3 Regarding development: Rani has cassava chips as a snack. She also has other snacks in her cupboard. Let's find out how much Rani has in her snack basket.


80 grams = … decigram


100 grams = … decagram


300 grams = … centigram

4 One morning, Setiawan returned from the supermarket with his father. Upon arriving home, Doni met Tina, Tono, and Tini. Setiawan gave Tina a 50-gram snack of Tango, then gave Tono an 80-gram snack of Lays and gave Tini a 200-gram snack of Tela. How many grams of snacks did Setiawan give to his friends in total? Then, convert the total amount of food Setiawan had to hg?

5 Put a >, <, or = sign in the following questions!

a)  .... 

200 grams 70 grams

b)  .... 

150 grams 1,5 ounce

c)  .... 

80 grams 2 ounce

6 Doni bought 200 grams of chocolate cassava chips and 150 grams of biscuits. What is the total weight of Doni's snacks? What is the total weight of Doni's snacks?

7 Match the snacks according to their weight!

- 210 grams
- 150 grams
- 280 grams

8 Match the weight of the snacks according to their weight!

□ = 100 grams

- □ □
- □ □ □
- □ □ □ □

9 Look at the following picture, then circle the correct weight of the snack!

	The weight of the snack is...	
	530 ons	530 grams
	The weight of the snack is...	
	550 grams	550 kilograms

10 Dani is a smart kid; he always gets first place in school. This semester, Dani won first place again and received 4 packages, each containing 200 grams of chocolate cassava chips and 2 100 grams of wafers. How many snacks does Dani have in total? How many ounces do Dani's snacks weigh now?

The Formative Evaluation Stage

In the formative evaluation stage, all ten items were retained, and the revised set was designated as Prototype 1 for subsequent testing. At this stage, the researcher also asked the Grade 2 classroom teacher, HJ Rohati Agustina, S.Pd., to review and validate the accompanying learning materials. During the expert review phase, Prototype 1 was examined by three validators with respect to content, construct, and language, through a combination of face-to-face meetings and email communication. The validators were: (1) Dr. Sri Adi Widodo, M.Pd., a lecturer and researcher in mathematics education at Universitas Sarjanawiyata Tamansiswa, Yogyakarta; (2) Minarni, S.Pd., the principal of SDN 04 Talang Kelapa; and (3) Ponirah, S.Pd., the Grade 2 homeroom teacher at Santo Leo 3 Cikarang School.

Table 2 presents their comments and suggestions on Prototype 1. Across the ten items, none were judged unsuitable; all were considered usable, although some required major revision, some minor revision, and some no revision. The validators' comments were then used as a basis for revising Prototype 1, which was subsequently used in the one-to-one phase.

Table 2. Comments and suggestions from three validators

Question Units	Comments and Suggestions	Major revision / minor revision / no revision / not suitable		
		Validator 1	Validator 2	Validator 1
1	*Validator 1:* In question unit 1, what is the purpose of the image? How much do 3 biscuits bought from the supermarket weigh? How much biscuits bought from the supermarket weigh on Monday and Tuesday? *Validator 2:* In question unit 1, the story problem is too long and the image is unclear. *Validator 3:* The image should be removed. The imperative sentence in the question needs to be changed. The question format needs to be slightly revised.	Major revision	Major revision	Minor revision
2	*Validator 1:* In question unit 2, the objective of the question is unclear, and the cognitive level is still at C1. If the question is intended to maintain its cognitive level, it would be better if students were asked to describe the weight of an object on a scale. This image is not clearly visible.	Major revision	Major revision	Minor revision

	Validator 2: In question unit 2, the image is unclear, and second-grade students still cannot understand it. *Validator 3:* The question format needs improvement.			
3	*Validator 1:* In question unit 3, what are the snacks? The scale image doesn't look clear enough. *Validator 2:* In question unit 3, the image is unclear and too tall. *Validator 3:* Remove the scale image and add the snack image and add the question.	Major revision	Major revision	Minor revision
4	*Validator 1:* In Unit 4, the context of hectogram was unfamiliar to students. The units of weight that children are familiar with are kg, grams, and ounces. *Validator 2:* In Unit 3, the image was unclear and too high. *Validator 3:* In Unit 4, the questions should not be set too high; we must understand the limits of children's abilities.	Minor revision	Major revision	Minor revision
5	*Validator 1:* No comments *Validator 2:* In question unit 5, the question development is in line with the textbook and the abilities of second-grade students. *Validator 3:* It's good enough, but the question wording needs to be changed slightly. Reorganize the image layout.	Without revision	Without revision	Minor revision
6	*Validator 1:* In unit 6, the context of "dg" is unfamiliar to students. The units of weight that children are familiar with are kg, grams, and ounces.	Minor revision	Minor revision	Minor revision

	Validator 2: In unit 6, the question development is appropriate, but for second-grade students, converting units from grams to decigrams/dg is too complex. *Validator 3:* The question is good enough.Questions about converting units of weight to "decigram" should be changed to "ounces" or "kilogram."			
7	*Validator 1:* In question unit 7, the scale image doesn't show the dimensions. *Validator 2:* In question unit 7, the image is unclear. *Validator 3:* The command sentence in the question should be improved. The scale image should be clarified.	Minor revision	Minor revision	Minor revision
8	*Validator 1:* In question 8, the image of the scale is too small, especially the weight. *Validator 2:* In question 8, the image is unclear. *Validator 3:* The imperative sentence in the question should be improved. The image of the scale should be made clearer.	Minor revision	Minor revision	Minor revision
9	*Validator 1:* There were no comments on question unit 9. *Validator 2:* In question unit 9, the question development was appropriate. *Validator 3:* Which command sentence in the question needs improvement?	Without revision	Without revision	Minor revision
10	*Validator 1:* There were no comments on Unit 10 questions. *Validator 2:* In Unit 10 questions, the development of the questions was too advanced for Grade 2. *Validator 3:* Question format that needs improvement	Without revision	Revisi Mayor	Minor revision

In the one-to-one stage, the revised Prototype 1 was administered to three Grade 2 students at State Elementary School 04 Talang Kelapa. Student feedback on the items is summarized in Table 3, based on a format used in Mangelep's (2018) study. The three students, representing high, medium, and low mathematical achievement levels, reported that Item 1 was difficult, items 2, 3, 6, and 7 were easy to understand, and that the instructions for Items 4 and 5 were not sufficiently clear. They also indicated that Item 8, involving conversion to decimal units, was difficult, and that Items 1, 9, and 10 were perceived as too long.

Table 3. Comments and suggestions from students in the one-to-one stage

No	Comments/Suggestions	P1	P2	P3
1	Question number 1 is difficult	✓	✓	✓
2	Questions number 2, 3, 6, and 7 are easy to understand	✓	✓	✓
3	The instructions for question number 4 are not clear	✓	✓	✓
4	Question number 4 is difficult to do	✓	✓	✓
5	Question number 5, the instructions are not clear enough, so it is confusing.		✓	
6	Questions number 1 and 4 are difficult to do	✓		
7	Questions numbers 1, 4 and 5 are difficult to do		✓	✓
8	Question number 8 changing to decimal is difficult and I don't understand it yet.	✓	✓	✓
9	Questions numbers 1, 9, and 10 are too long			✓

Description:
P1: Students with high mathematical ability
P2: Students with average mathematical ability
P3: Students with low mathematical ability

This stage resulted in ten items judged to be valid in terms of content. To further strengthen the quality of the items, the Grade 2 homeroom teacher, HJ Rohati Agustina, S.Pd., was again invited to review the revised version. At this point, the questions and learning materials were considered appropriate and no further revisions were deemed necessary. The revised Prototype 1 was then designated as Prototype 2.

In the small-group stage, Prototype 2 was administered to six Grade 2 students at State Elementary School 04 Talang Kelapa, in addition to the three students who had participated in the one-to-one phase. Students were asked to comment on the items they had worked on, with the goal of determining whether they understood the revised prototype. Their responses, presented in Table 4 following Mangelep (2018), indicate that some students found the questions clear and easy, whereas others reported not yet being fluent in counting to hundreds or in reading certain items (particularly Items 1, 9, and 10).

Table 4. Student comments in the small group stage

No	Comments	P1	P2	P3	P4	P5	P6
1	The questions are clear, and you understand the instructions for the questions.	✓	✓		✓		

2	The questions given are easy	✓			✓		
3	Not yet fluent in counting to hundreds			✓		✓	✓
4	Not yet fluent in reading difficulties 1,9 and 10			✓		✓	✓

Description:
P1 and P2: Students with high mathematical abilities
P3 and P4: Students with average mathematical abilities
P5 and P6: Students with low mathematical abilities

In addition to eliciting student comments, the researcher analyzed students' written work to gauge their level of understanding and to examine the practicality of the questions. A summary of student scores for this phase is presented in Table 5 (following Mangelep, 2018).

Table 5. Recapitulation of student grades

No	NP	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	ANBP	3	2	3	4	2	3	3	4	5	4
2	MZ	3	2	3	4	2	3	3	4	5	4
3	WA	0	2	3	4	2	3	3	0	0	4
4	MNMA	3	2	3	4	2	3	3	4	5	4
5	RJ	0	2	0	4	2	3	3	0	0	0
6	AR	0	2	3	4	2	3	3	0	0	0

Description:
NP: Student Name
S1: Question 1

On the basis of the interview data and the analysis of students' written responses, Prototype 2 was revised again. The revised version, Prototype 3, consisted of ten items accompanied by test sheets and learning materials that were deemed both valid and practical. The final version of the ten snack-based weight measurement problems is shown in Table 6.

Table 6. The last prototype of 10 questions

Question units	Question
1	On Monday, Doni bought 3 biscuits weighing 450 grams. On Tuesday, Doni bought 2 more biscuits weighing 300 grams. How much did Doni buy on Monday and Tuesday?
2	Match the following snack pictures according to their weight!  • • 80 grams

• • 250 grams

3 Match the following snack pictures according to their weight!

▯ = 100 grams

• • ▯▯

• • ▯▯▯ ▯▯▯

• • ▯▯ ▯▯

4 Reni went to the supermarket to buy 150 grams of biscuit snacks. However, Reni still needed two other snacks to give to Lani. These two snacks are:

a) Cassava chips, 70 grams, and

b) Potatoes, 50 grams.

Circle the snacks according to their weight...

 

A B

 

A B

5 Circle the weight of the snack according to the picture on the side correctly!

	The weight of the snack is... A. 530 ounce B. 530 grams
	The weight of the snack is... A. 550 grams B. 550 kilogram

6 Put a >, <, or = sign at the following points!

a)  .... 

80 grams 2 ounce

b)   .... 

1 ounce 600 grams

c)  .... 

80 grams 2 ounce

7 Rani has cassava chips as a snack, and she also has other snacks. Write down the weight of the cassava chips, potato chips, wafers, and biscuits she has!

200 grams = ... ounce

400 gra = ... ounce

300 grams = ... ounce

8 Doni bought 200 grams of chocolate cassava chips and 300 grams of biscuits. What is the total weight of Doni's snacks? Convert the total weight of Doni's snacks into ounces!

9 In the morning, Setiawan met Tina, Tono, and Tini. Setiawan gave Tina a snack in the form of a wafer weighing 50 grams, then gave Tono a biscuit weighing 150 grams, and gave Tini 200 grams of chocolate cassava chips. What is the

	total weight of the snacks Setiawan gave to his friends? Convert the total weight of the snacks that Setiawan has in ounces!
10	In this semester, Dani won first place and received 4 chocolate cassava chips weighing 200 grams. The cassava chips were then given to his older brother, 2 pieces weighing 100 grams. What is the total weight of the snacks that Dani has now? Convert the total weight of the snacks that Dani has into ounces!

In the field test stage, Prototype 3 was administered to 17 second-grade students. Student responses were scored using an achievement interval aligned with guidelines from the Ministry of Education and Culture, with a minimum mastery criterion (KKM) of 60 for the subject. The distribution of scores is presented in Table 7. The results show that 9 students (47.05%) achieved scores in the "very good" category (88–100), 7 students (41.17%) in the "good" category (74–87), 1 student (5.88%) in the "enough" category (60–73), and 1 student (5.88%) in the "not enough" category (below 60). The overall average score was 84.82%, which falls in the "good" category.

Table 7. Field test stage results

No	Interval	Frequency	Percentage	Category
1	88 – 100	9	47,05%	Very good
2	74 – 87	7	41,17%	Good
3	60 – 73	1	5,88%	Enough
4	< 60	1	5,88%	Not enough
Total		17	100%	
Average		84,82%		Good

These results indicate that, on average, students were able to answer the developed questions with good performance. Consequently, the ten snack-based contextual problems for teaching weight measurement using the PMRI approach can be considered effective in terms of their potential effect on students' mathematical understanding.

Discussion

The findings of this study indicate that the ten PMRI-based weight measurement items situated in snack contexts met the criteria of validity, practicality, and effectiveness. This outcome reinforces the argument that contextualization in mathematics learning particularly through the use of familiar objects such as snacks can enhance students' engagement and their understanding of abstract concepts like weight measurement (Stage & O'Neill, 2025; Yansen, 2024; Sakiman et al., 2023). The positive student responses and the average achievement score of 84.82% suggest that the developed items are not only aligned with the curriculum but also provide meaningful learning experiences.

These results are consistent with previous studies that highlight the role of PMRI in connecting mathematical ideas with students' real-life experiences (Mardia et al., 2023; Hermawati, 2016). Muchlis (2012) argues that contextualized learning supports the development of students' critical thinking and problem-solving skills, while Charmila et al. (2016) report that culturally relevant and authentic contexts can improve mathematical literacy as measured by PISA-like items. In the present study, the use of snacks as contextual anchors resonates strongly with elementary students, given their daily encounters with such items in school and community settings (Muslimin, 2022). This is in line with Lisnani and Widagda (2020), who contend that familiar food items can effectively situate abstract mathematical concepts in everyday situations.

The expert review process further showed that although several items required revision for example, in terms of cognitive level specification, linguistic simplicity, and clarity of images the overall design was deemed appropriate. This iterative refinement reflects the core principles of design research, in which prototype evaluation and systematic revision are central to ensuring the quality of learning tools. The validators' recommendations to adjust unit conversions (from decigrams to more familiar units such as grams and ounces) emphasize the importance of attending to students' developmental readiness when constructing mathematical problems for young learners.

Furthermore, the study highlights the potential of PMRI-based assessments to function not only as evaluative instruments but also as vehicles for learning. As Putra et al. (2016) note, contextual problem design does more than test students' existing knowledge; it actively contributes to learning by stimulating reasoning and supporting connections between prior experiences and new mathematical concepts. This dual role was evident in students' feedback in this study, where initially challenging items such as those involving unit conversions and multi-step operations ultimately fostered deeper engagement and collaborative discussion.

From a pedagogical standpoint, the findings suggest that teachers should make greater use of contextualized, student-centered assessment tools in mathematics. Such tools are consistent with the intent of the 2013 Curriculum, which emphasizes active learning and thematic integration, and they respond to the pressing need to improve Indonesian students' performance on international assessments such as PISA (Kemendikbud, 2019). The results thus reaffirm the relevance of PMRI as a framework for narrowing the gap between students' everyday experiences and formal mathematics learning (Nabillah et al., 2023; Bellinda et al., 2023). Finally, this study opens several avenues for future research. Subsequent studies could broaden the range of snack contexts to include more diverse and locally specific items or incorporate technology-based media such as digital worksheets or interactive simulations to enhance accessibility (Sari & Noviartati, 2022). Comparative investigations across grade levels or educational settings could also deepen understanding of how PMRI-based contextualization supports the long-term development of students' mathematical literacy (Mulbasari, 2024).

Conclusion

The study resulted in ten snack-based weight measurement items that successfully passed expert review, one-to-one trials, small-group trials, and a field test. These outcomes indicate that both the test items and the accompanying learning materials can be regarded as valid, practical, and effective (i.e., having potential effects). The ten items are suitable for use in Grade 2 to address Core Competencies 3.6 and 4.6 related to weight measurement in Theme 6 and can be employed to assess students' understanding by connecting mathematical content to everyday contexts.

The items are considered valid because, during the expert review phase, none were judged inappropriate; all were deemed acceptable, although several required revisions based on the experts' comments and suggestions. Following these revisions, the items were trialed in the one-to-one phase to examine their performance in the field and were subsequently refined again. The items can be classified as practical because they support students in interpreting and responding to the questions. They can also be regarded as effective (having a potential effect) because students responded positively to the items and an average score of 84.82% of the maximum possible score was achieved, indicating that most students answered correctly.

In light of these findings on the development of PMRI-based weight measurement problems in snack contexts, several recommendations can be offered. First, the products of this study may serve as a reference or starting point for other researchers who wish to design PMRI-oriented assessment tasks in different contextual domains. Second, for researchers interested in extending this work within snack contexts, it would be advisable to incorporate a wider range of snack types and a broader set of indicators so as to capture more diverse aspects of students' mathematical understanding.

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Conflicts of Interest

The authors declare no conflict of interest related to the publication of this manuscript. Furthermore, all ethical considerationsn such as plagiarism, research misconduct, data fabrication or falsification, duplicate publication or submission, and redundancy have been fully addressed by the authors.

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