IMPROVING PROBLEM-SOLVING SKILLS OF STUDENTS THROUGH GADS (GIVEN, ASKED, DRAWING/REPRESENTATION, SOLUTION)

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Completed 2022

Improving Problem-Solving Skills of Students Through GADS (Given, Asked, Drawing/Representation, Solution)

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Abstract

Teaching mathematics is the main goal of encouraging students to solve issues in everyday life. Regretfully, the 2018 NAT results show that most pupils struggle with solving arithmetic puzzles. This is one of the factors contributing to the perception of relatively low overall mathematics achievement. Therefore, to contribute a solution to the problem, this study aims to improve students' problem-solving skills using the GADS (Given, Asked, Drawing/Representation, Solution) template and to determine the difficulties students meet in solving Math word problems. The participants are the 30 Grade- 9 students enrolled in Guipos NHS, Guipos District, Zamboanga del Sur Division, for the school year 2022-2023. This study's data were gathered using both quantitative and qualitative techniques. The qualitative information obtained from the interview was interpreted using thematic analysis. The mean score, standard deviation, and t-test were used to treat the quantitative data. The improvement of their problem-solving skills can be seen from the increased average score and its corresponding percentage of students' mathematical problem-solving skills in the pre-test from 5.57 or 15.46%, interpreted as Very Less, to 19.3 or 53.61% in the post-test, interpreted as Not Enough. The results showed that the GADS template could improve students' mathematical problem-solving skills. As a result of this research, the researcher plans to encourage all Mathematics teachers not to skip discussing complex competencies on problem-solving in all their Math classes and develop a problem-solving workbook with the GADS template to provide students a consistent exposure to problem-solving.

Keywords: *GADS template; Mathematical difficulties; Problem-Solving skills*

Acknowledgment

This research would not have been possible without the valuable assistance of many people. First and foremost, the researcher acknowledges her creator, the almighty God, for giving her the time and strength to finish this action research. The researcher expresses her profound gratitude to her Principal for pushing her to finish the research. To the researcher's daughter, colleagues, and friends in school who have been supportive and helpful. For all the Grade-9 students of SY 2022-2023, who honestly answer the test and the interview, the researcher is also extending her sincere gratitude.

Context and Rationale

A person's capacity to engage in cognitive processing to comprehend and address difficult problems is referred to as their problem-solving capability where a solution is unavailable in a snap. These situations engage a person's mind to develop a possible solution. Globally, curriculum in mathematics education place a high importance on problem-solving. However, its components and the extent varied by country (Peranginangin and Surya 2017). According to the National Council of Teachers of Mathematics (2012), the main goal of the mathematics course is indeed problem-solving abilities. In the 2018 Programme for International Student Assessment (PISA) education study conducted by the Organization for Economic Cooperation and Development (OECD), the Philippines placed second lowest in Mathematics among the 79 nations, with 353 points, 136 points lower than the average 489.

Furthermore, 2018 NAT result data revealed that students in the communities lack mathematical problem-solving skills, having an MPS of as low as 44.59%. Thus, this became one of the causes of poor performance in mathematics. The regional NAT MPS of the Division of Zamboanga Del Sur is only 31.93% in Mathematics, and Guipos NHS also got 33.02% DAT MPS in Mathematics last year. The Grade-9 MPS in Mathematics jived in with an MPS of only 31.15%.

The Curriculum and Learning Management Division of the Department of Education's Regional Office 02 published an assessment of the 2018 NAT results. Their analysis includes the following: general findings, conclusions, and recommendations. One of the 21st-century skills measured in the 2018 NAT is problem-solving, and the office recommends that educators concentrate on improving instructional and intervention materials. These materials are expected to assist students improve their problem-solving skills and eventually, through strategic implementation, contribute to higher-quality outcomes. For many years, one of the primary goals of mathematics has been to assist students in developing their problem-solving skills. In the same league, educators also do their part and work tirelessly to develop effective methods for assisting students in becoming better problem solvers in real-world situations. Until now, many researchers have continued to investigate practical methods for improving students' abilities. Mathematics teachers should give students plenty of opportunities to solve word problems in their classes. This way, they would feel more comfortable doing so. Allowing students to participate in this activity may aid their mathematical reasoning and thinking.

According to Sánchez-Martin et al. (2017) choosing a learning model that emphasizes problem-solving activities is one solution to circumvent students' low ability to solve math problems. To achieve success in mathematics, teachers are expected to continue to impart students problem-solving skills in an ample amount of time and, consequently, in the most efficient way possible. Incorporating learning methods and applicable models is critical to enhancing students' problem-solving abilities. In a combined effort, the teacher should act as a facilitator instead of just a learning center for the students (Hobri et al. 2020).

A common observation among Guipos National High School Mathematics teachers is that students struggle to solve word problems related to the subject. This observation could be due to a fear of problem-solving, lack of comprehension, lack of knowledge of the problem at hand, procedural errors, or the problem's difficulty level. These students struggle to solve worded Math problems, and their performance deteriorates during pandemics when teachers cannot guide them through various worded problems. Effective problem-solving requires careful planning on the part of the mathematics instructor, active participation from the students in the learning-teaching activities, and a vital role for the facilitator—teaching problem-solving using a model or other guide—when teaching the skill.

Thus, the researcher devised a new model called GADS (Given, Asked, Drawing/Representation, and Solution), anchored in Polya's model, that aims to enhance the problem-solving skills of Grade-9 students of Guipos National High School S.Y. 2022–2023. The GADS model improves problem-solving skills and motivates students to solve word problems in Mathematics 9.

Innovation, Intervention, and Strategy

In this study, a problem-solving template/model called GADS was used. This model is expected to help improve the problem-solving skills of Grade 9 students in any learning modality. Learning to solve math problems also needs the participation of the other party. In other words, the process necessitates learners' compliance in following the process to find the solution, resulting in a guided and straightforward process (Widodo 2018). GADS is a problem-solving model that involves four steps to solve any problem, anchored from Polya's model.

(1) **Given** (Identifying the known). In this step, the learners identify and extract all the data/information given in the problem.

(2) **Asked** (Identifying the unknown). At this step, the learners identify the unknown data. This refers to what is asked in the problem or the data we seek to solve the problem.

(3) **Drawing/representation of the problem.** In this step, students search for connections between known and unknown data, which leads to the question of how the known information will be interconnected to procure the unknown things. It refers to transforming problems into mathematical sentences or envisioning the problem by outlining or writing down the key components of the issue.

Lastly, (4) **Solution.** This step includes carrying out computations using all relevant data, including concepts and, when applicable, formulas or equations.

Students' problem-solving skills should improve due to this model and their problem-solving engagement and motivation to learn Mathematics. It also shifts students' attitudes about problem-solving from negative to positive. Students will no longer be likely to dodge mathematical problems when using GADS.

Action Research Questions

This study aims to improve the problem-solving skills of grade 9 students through the GADS model.

Specifically, it attempts to answer the following questions:

1.) What difficulties do students meet in solving word problems?
2.) What are the students' problem-solving skills before and after the use of GADS model?
3.) How does the use of GADS template help students in solving Math problems?

Action Research Method

Research Design

This study employed mixed-methods research, particularly an explanatory sequential design, which entails collecting quantitative and qualitative data from participants. This design involves an initial quantitative instrument phase and a qualitative data phase.

Participants and/or other Sources of Data and Information

The participants of this study are the 30 Grade 9 students enrolled in Guipos National High School, Guipos District, in the Division of Zamboanga del Sur, for 2022-2023.

Table 1: Criteria of Population and Sample Population

Section	Population	Sample Population
Grade 9 Pearl	48	5
Grade 9 Sapphire	44	5
Grade 9 Jade	44	5
Grade 9 Emerald	46	5
Grade 9 Garnet	44	5
Grade 9 Ruby	50	5
Total	**276**	**30**

Table 1 shows the Criteria for Population and Sample Population. The sample population of this study was determined through random sampling.

Research Instrument

Both quantitative and qualitative methodologies were employed in the collection of data for this investigation. The first instrument used was a problem-solving test consisting of 4 worded problems adapted from (Gabas 2012). A validated test-scoring framework on problem-solving skills adapted from (Peranginangin and Surya 2017) was used to measure and analyze students' problem-solving skills. Another tool utilized in the qualitative part is a structured interview on the experiences, feelings, and difficulties students encounter when solving math word problems. The researcher allows the participants to express their thoughts on how the GADS template helps them improve their problem-solving skills.

Below are the test-scoring guidelines used to measure and analyze the participants' problem-solving skills.

Table 2: Test Scoring Guidelines on Problem-Solving Skills

Rated Aspect	Reaction to The Problem	Score
Given (Known)	No data given	0
	Incomplete in writing the given data	1
	Correct and complete in writing the given data	2
Asked (unknown)	No data given	0
	Incomplete in writing what is ask in the problem	1

	Correct and complete in writing what is asked in the problem	2
Drawing/representation of the problem	No drawing or representation of the problem	0
	Drawing and representation of the problem is incorrect	1
	Drawing and representation of the problem is incorrect	2
Solution	Did not make calculations.	0
	Perform calculations with implementing plans that have been made properly and the result is not correct.	1
	Perform calculations with implementing plans that have been made properly and the result is correct.	2
	Perform calculations with implementing plans that have been made properly and the result is correct and examine if asked is answered.	3

To calculate the percentage of the total score for each indicator of problem-solving ability, the formula of (P_k) will use :

$$P_k = \frac{\text{Acquisition score of the indicator}}{\text{Total score of the indicator}} \; x\ 100\%$$

k = 1,2,3,4

Table 3: Percentage Interpretation Criteria

Percentage	Interpretation
$85 \leq P_k \leq 100$	Very Good
$70 \leq P_k \leq 84.99$	Good
$55 \leq P_k \leq 69.99$	Good Enough
$40 \leq P_k \leq 54.99$	Not Enough
$0 \leq P_k \leq 39.99$	Very Less

Data Gathering Procedure

To collect data, it was necessary to tell research participants about the goal and importance of the project. As a first step in gathering data, informed consent was given to the participant's parents. After guaranteeing that the learners and their parents understood the study, the researcher administered the pre-test to measure and analyze the participants' problem-solving skills. Then, the participants answered the interview through a questionnaire to explain and justify the pre-test result.

There was an introduction or an orientation of the GADS template, then a similar problem-solving test utilizing GADS template was given to participants.

Data Analysis

The researcher employed thematic analysis to analyze the qualitative data. Analyzing the quantitative data on problem-solving abilities required the use of descriptive statistical metrics like mean and average. To determine the significance of the difference,

the repeated measures of the Paired Samples T-test were used to determine if the intervention improved the problem-solving skills of Grade-9 students.

Results and Discussion

This section delves into the results obtained from the study, offering a comprehensive analysis and interpretation that sheds light on the implications and significance of the findings.

Pre-Test and Post-Test Results of Students' Mathematical Problem-Solving Ability

Table 4 displays the students' pre- and post-test results for their ability to solve mathematical problems.

Table 4: Students' Score in Pre-Test and Post Test

NO.	PRE-TEST (36)	POST-TEST (36)		NO.	PRE-TEST (36)	POST-TEST (36)
S1	7	21		S16	4	18
S2	4	16		S17	2	18
S3	6	20		S18	4	14
S4	6	26		S19	5	21
S5	8	18		S20	3	15
S6	8	19		S21	2	25
S7	3	19		S22	6	15
S8	7	19		S23	3	17
S9	6	22		S24	7	17
S10	9	24		S25	6	24
S11	5	21		S26	8	19
S12	6	17		S27	2	16
S13	4	20		S28	2	17
S14	5	10		S29	12	31
S15	10	22		S30	7	18
				Total	167/1080	579/1080
Mean score					5.57	19.3
Interpretation					15.46% Very Less	53.61% Not Enough

Table 4 revealed a remarkable rise in students' performance across all aspects required for successful problem-solving. The average score climbed from 5.57 to an impressive 19.3.

Table 5: Problem-solving ability percentage-based indicators of problem-solving

Item 1	Score of Students (Pre-Test)	Total Score	Percentage	Interpretation	Total Score (Post-Test	Percentage	Interpretation
Given	12	60	20%	Very Less	54	90%	Very Good
Asked	0	60	0%	Very Less	52	87%	Very Good
Drawing	17	60	28%	Very Less	38	63%	Good Enough
Solution	38	90	42%	Not Enough	57	63%	Good Enough
Item 2							
Given	5	60	8%	Very Less	26	43%	Not Enough
Asked	0	60	0%	Very Less	50	83%	Good
Drawing	24	60	40%	Not Enough	33	55%	Good Enough
Solution	16	90	18%	Very Less	29	48%	Not Enough
Item 3							
Given	0	60	0%	Very Less	26	43%	Not enough
Asked	0	60	0%	Very Less	45	75%	Good
Drawing	8	60	13%	Very Less	27	45%	Not enough
Solution	18	90	30%	Very Less	31	51%	Not Enough
Item 4							
Given	0	60	0%	Very Less	16	25%	Very Less
Asked	0	60	0%	Very Less	41	68%	Good Enough
Drawing	12	60	20%	Very Less	27	45%	Not Enough
Solution	18	90	30%	Very Less	31	34%	Very Less

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Percentage	Interpretation
$85 \leq P_k \leq 100$	Very Good
$70 \leq P_k \leq 84.99$	Good
$55 \leq P_k \leq 69.99$	Good Enough
$40 \leq P_k \leq 54.99$	Not Enough
$0 \leq P_k \leq 39.99$	Very Less

The results of the problem-solving test demonstrated an impressive improvement. Students soared from a mean score of 5.57 in the pre-test to 19.3 in their post-test, indicating noteworthy advancement within one step and across all stages necessary for problem-solving.

Effect of GADS template in improving problem-solving skills.

Table 6 displays the study results that determined the significant difference between students before and after using the GADS template through paired sample t-tests. The use of GADS resulted in a t-value of -20.568 and a p-value of .000, less than the significance level. Hence, there is a significant difference in students' problem-solving skills before and after using the GADS template.

Table 6: Test of Significant Difference on Pre-Test and Post-Test

	N	t-value	Df	p-value	Decision	Interpretation
Before GADS	30	-20.568	29	.000	Reject the null hypothesis	There is a significant difference
After GADS	30					

*significance at the 0.05 level

With the GADS template, the students could navigate how to solve the problems in the first step and the following step until the end of the solution process. With GADS, they were able to develop a familiarity with the steps, which led to better scores in all the participants' papers.

Students Feelings towards Solving Math problems

Students varied mathematical experiences shape their attitudes towards the subject (Davadas and Lay 2017; Goldin et al. 2016). Students' attitudes towards specific objects and subjects are shaped by their cumulative experiences, which can have a good or negative effect on their psychological well-being. The researcher also conducted a short interview to further assess the factors in the problem-solving process. The interview primarily looks into how the students felt after solving the problems, which is correlated to their overall attitude toward solving a problem.

Nervous/ fear: Most of the participants in this action research shared feeling nervous and scared. Here are the recurring responses by the participants

"Nervous, overthinking what if I cannot answer, what if my answers are all wrong?" (S5 and S6)
"I am worried about not getting the correct answer because I am not good at math." S8
"I feel nervous because I only knew a little and sometimes I forget how to solve." S14
"My feeling when solving Math word problems is always nervous." S18
"I feel nervous and scared." S19
"I usually get nervous cause whatever I'd do, I really can't understand ma'am because I am not good in Math." S23
"I feel nervous, very, very, nervous whenever I solve worded problems." S24

Confused: The second recurring theme extracted from the interview is 'confusion.' The participants were hesitant to do problem-solving tasks because they felt confused. This theme appeared three (3) times during the interview proving the theme to be useful and meaningful as data.

"I am confused and at the same time nervous because I can't understand the problem." S9
"Whenever I solve problems I'm confuse, dizzy and sleepy." S13
"I am really confused on how to start." S29

The results reveal that many students have negative feelings toward solving worded problems, and one of the most recurrent and evident are nervousness and fear. Feeling nervous and afraid indicates they may feel pressure to solve problems, meaning they lack

confidence in their skills. This theme has been recurrent seven (7) times, making it a notable theme concerning their attitudes and feelings toward Mathematics.

Attitudes toward Mathematics correlate with how students view and interact with the subject. Those who approach Math positively find it enjoyable, see its worth in their lives, and are confident when taking on mathematical tasks. (Mullis et al. 2020)

Two participants (S8 and S23) also pointed out a specific issue in their response: ' I am not good at math.' These statements evoke responsibility from the students. This means they take full responsibility for their inability to solve worded problems or their plausible mistakes during the test. According to Hwang and Son (2021), a relationship exists between the success of the subject and the attitudes of the students towards it.

Learning and emotions are like two sides of the same coin. Positive feelings in an educational setting can be a powerful asset for students, inspiring them to reach for greater heights; however, negative ones can have crippling effects on students' capacity for growth. Similarly, educators and students influence each other's emotional states - both consciously and unconsciously. Thus, both parties are responsible for creating either vibrant or toxic learning environments, depending on how they manifest (Lodge et al. 2022).

Furthermore, negative emotions like anxiety, stress, and sadness can impede our learning ability by depriving us of motivation and disrupting effective development. Worry and fear may appear helpful in the short term but leave lasting negative impacts on learning disposition. In this study, the student's disposition and feelings towards problem-solving and mathematics, in general, significantly affect their performances in solving problems.

Difficulties Met by Students in Solving Math Problems

Difficulty in remembering math facts, concepts, rules, formulas, and procedures.

First, the students express their memory problems with math concepts, rules, formulae, and procedures, as revealed in the responses below:

"I forgot about the basic in Math." S15, S13, S12:
"I had difficulty remembering the basic concepts. S29
"I have a poor memory, I easily forget the lesson." S18
"I did not remember how to solve it." S30
"I don't know how to solve the problem and I don't know the formula." S11
"I don't know how to divide when I forgot the formula ma'am." S5, S6

Difficulty in comprehending and visualizing mathematical concepts

Secondly, they reported having trouble understanding and picturing mathematical ideas related to the problem.

"I can't understand the problem." S9
"I don't know how to solve the problem" S14
"I could hardly understand the topic or lesson." S24
"There are a lot of words that I cannot understand." S23
"I can't understand anything." S28

Effects of Using GAD Methods

To highlight the effects of using the GADS method, the researcher also classified the students' responses to the question, "How did the GADS template help you in solving worded math problems?" into two categories.

1. **It made the problems easier to understand**

"I was able to identify the necessary information easily from the problem."

"I was able to formulate the equations which describe the relationship between the variables in the problem."

"It helped me understand the situations easier and gave me the idea on how to solve the problems.

2. **It provided students a clear focus and direction**

It guided me to solve the problem."

"If I find it hard to do the next step, I can go back with the previous step to give me a clue how to continue."

"It guided me in every step of the solutions.

"Math language is quite confusing, but in writing procedures in the solutions, it made the steps logical. It was like organizing a plan for doing a particular task."

These categories highlight some important goals the GADS template tries to achieve. The first is *understanding.* Students can only solve a problem correctly by understanding it first. This data set shows how the GADS template assists in the student's understanding of the problem/s.

Secondly, *focus and direction.* This data set indicates that the use of the GADs template assists in making it easier for a student to solve a problem. The pre-test interviews revealed that students were having difficulty because of confusion. So, the responses during the post-test indicate that the GADS template fostered better concentration and boosted the student's morale and interest in solving problems.

Conclusions and Recommendations

The conduct of the study shed light on the following conclusions:

First, the researcher finds it necessary to encourage problem-solving in students by appropriately developing problem-solving activities or exercises necessary for the learners to improve their problem-solving skills. Having ample exposure to problem-solving can boost their confidence, build a better environment, and nurture better attitudes towards problem-solving and their scores.

The researcher also acknowledges and strongly encourages providing students with problem-solving exercises utilizing the GADS template. This way, they are consistently engaged with word problems not only during a single level of education but to accustom students in solving word problems whatever year level they are in.

Teachers should discuss competencies in problem-solving. They should allot time for it in all their classes as much as possible. Time and consistency are essential in a student's retention in mathematics and all subjects. Giving students enough time to work with word problems may sound challenging. However, it will positively affect students' feelings towards word problems, as exposure will propel them closer to being more comfortable with problem-solving.

Develop problem-solving materials/exercises through a workbook. Establishing explicit, efficient, and creative materials and exercises for students to work with is a good start in letting students develop a positive interest in problem-solving. As for the educator's side, having an organized set of materials, partnered with ample creative freedom for the teacher's unique teaching style, will make teaching more manageable for them. The researcher finds instituting a workbook essential in enhancing students' problem-solving skills.

Action Plan

Goals/ Objectives	Activities/ Strategies	Persons Involved	Resources Needed	Time Frame	Success Indicator
To encourage Math teachers not to skip on discussing competencies on problem solving and to allot time for problem solving utilizing GADS template in their problem -solving activities	Learning Action Cell on Problem Solving using the template	Math Teachers	Computer, Internet Connection	March 2023	90-100% of participants will be encouraged to use GADS template in problem solving activities
To develop a workbook of problem solving with GADS template	Learning Action Cell on Workbook making	Math Teachers	Computer, Internet Connection	July 2023	90-100% of participants will be able to develop a problem solving workbook with GADS template
To integrate solving worded problems using GADS template in the periodic test as part of the students' performance task	Quarterly Assessments	Math Teachers	Computer, Internet Connection	Quarterly	90-100% of participants will be encouraged to use GADS template in problem solving activities

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Financial Report

Activities	Quantity	Unit	Estimated cost	Total estimated cost
SUPPLIES AND MATERIALS				
A4 Bond paper 80 GSM	3	ream	₱ 245.00	₱ 735.00
T664 printer ink Cyan	1	refill bottle	₱ 375.00	₱ 375.00
T664 printer ink yellow	1	refill bottle	₱ 375.00	₱ 375.00
T664 printer ink magenta	1	refill bottle	₱ 375.00	₱ 375.00
T664 printer ink black	1	refill bottle	₱ 375.00	₱ 375.00
			SUBTOTAL:	₱ 2,235.00
Reproduction and Binding cost				
Binding of documents @ P150	6	instance	₱ 150.00	₱ 900.00
			SUBTOTAL:	₱ 900.00
			GRAND TOTAL:	**₱ 3,135.00**

Appendix A

Interview Schedule

A. Opening/Engaging Question

1. Describe briefly your feeling and experiences in solving Math word problems.

B. Core Questions & Probing Questions

1. What are your difficulties in solving Math word problems?

2, What do you think are the causes of those difficulties?

C. Terminating/Closing Question

1. How can the use of GADS helps you in improving your problem- solving skills?

Appendix B

Problem Solving Test Questionnaire (Pre- test)
Adapted from (Gabas 2012)

MELCS: Solves routine and non-routine problems involving area of composite figures. (M6ME-IIIh-90)
Solves problems involving parallelograms. (M9GE-IIIe-1)

Directions: Directions: Read and understand carefully the following problems. Solve by using the steps in problem solving. Show completely the necessary solution on the answer sheet.

1. A billboard is in the shape of a parallelogram. The billboard has a base of 20 feet and a height of 7 feet. Find the area of the billboard?

2. A baseball diamond is a square. The distance from the base to base is 25 meters. How far does the second baseman throw a ball to home plate?

3. Parallelogram WISH is a rectangle and its perimeter is 56 cm. One side is 5 cm less than twice the other side. What are its dimensions?

4. The area of a rectangular parking lot is 210 square meters. How wide is the lot if it is 20 meters long?

Appendix C

Problem Solving Test Questionnaire (Post- test)
Adapted from (Gabas 2012)

MELCS: Solves routine and non-routine problems involving area of composite figures. (M6ME-IIIh-90); Solves problems involving parallelograms. (M9GE-IIIe-1)

Directions: Directions: Read and understand carefully the following problems. Solve by using the steps in problem solving. Show completely the necessary solution on the answer sheet.

1. A billboard is in the shape of a parallelogram. The billboard has a base of 20 feet and a height of 7 feet. Find the area of the billboard?
Given:

Asked:

Drawing:

Solution:

2. A baseball diamond is a square. The distance from the base to base is 25 meters. How far does the second baseman throw a ball to home plate?
Given:

Asked:

Drawing:

Solution:

3. Parallelogram WISH is a rectangle and its perimeter is 56 cm. One side is 5 cm less than twice the other side. What are its dimensions?
Given:

Asked:

Drawing:

Solution:

4. The area of a rectangular parking lot is 210 square meters. How wide is the lot if it is 20 meters long?
Given:

Asked:

Drawing:

Solution:

Appendix D

Test Scoring Guidelines on Problem Solving Skills Adapted from (Peranginangin and Surya 2017)

Rated Aspect	Reaction to The Problem	Score
Given (Known)	No data given	0
	Incomplete in writing the given data	1
	Correct and complete in writing the given data	2
Asked (unknown)	No data given	0
	Incomplete in writing what is ask in the problem	1
	Correct and complete in writing what is asked in the problem	2
Drawing/representation of the problem	No drawing or representation of the problem	0
	Drawing and representation of the problem is incorrect	1
	Drawing and representation of the problem is incorrect	2
Solution	Did not make calculations.	0
	Perform calculations with implementing plans that have been made properly and the result is not correct.	1
	Perform calculations with implementing plans that have been made properly and the result is correct.	2
	Perform calculations with implementing plans that have been made properly and the result is correct and examine if asked is answered.	3

Percentage Interpretation Criteria adapted from Peranginangin & Surya, 2017).

Percentage	Interpretation
$85 \leq P_k \leq 100$	Very Good
$70 \leq P_k \leq 84.99$	Good
$55 \leq P_k \leq 69.99$	Good Enough
$40 \leq P_k \leq 54.99$	Not Enough
$0 \leq P_k \leq 39.99$	Very Less

To calculate the percentage of the total score for each indicator of problem solving ability, the formula of (P_k) will use :

$$P_k = \frac{\text{Acquisition score of the indicator}}{\text{Total score of the indicator}} \; x \; 100\%$$

k = 1,2,3,4

Appendix E

Informed Consent

I, the undersigned, confirm that (please tick box as appropriate):

1.	I have read and understood the information about the research, as provided in the Information Sheet dated _____.	☐
2.	I have been given the opportunity to ask questions about the research and the participation of my son/daughter.	☐
3.	I voluntarily agree to allow my son/daughter to participate in the research.	☐
4.	I understand I can withdraw at any time without giving reasons and that I will not be penalized for withdrawing nor will I be questioned on why I have withdrawn.	☐
5.	The procedures regarding confidentiality have been clearly explained (e.g. use of names, pseudonyms, anonymization of data, etc.) to me.	☐
6.	If applicable, separate terms of consent for interviews, audio, video or other forms of data collection have been explained and provided to me.	☐
7.	The use of the data in research, publications, sharing and archiving has been explained to me.	☐
8.	I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of the data and if they agree to the terms I have specified in this form.	☐
9.	Select only **one** of the following: • I would like my son/daughter's name used and understand what I have said or written as part of this study will be used in reports, publications, and other research outputs so that anything I have contributed to this project can be recognized. • I do not want my son/daughter's name used in this project.	☐ ☐
10.	I, along with the Researcher, agree to sign and date this informed consent form.	☐

Name of Participant: _____

_____ _____ _____

Name of Parent/Guardian Signature Date

Researcher:

NANITH L. BELLO _____ _____

Name of Researcher Signature Date