CoMon AProCh (CONTEXTUALIZED MONEY ANALOGY PROCEDURAL CHECKLIST): A KNOWLEDGE BOOSTER FOR STUDENTS' INTEGER ADDITION AND SUBTRACTION SKILLS

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Abstract

Understanding the concepts of algebra, trigonometry, calculus, and any other Mathematics topic requires learning addition and subtraction of integers. Thus, higher Math concepts are difficult to understand. These difficulties may be because of the student's lack of interest on the subject, short attention span and processing problems. The goal of this study was to boost the integer addition and subtraction skills of Grade 7 Balukbahan National High School students using CoMon AProCh as an intervention in the School Year 2022-2023. This study employed an experimental-descriptive research design following Hendricks' Action Research Cyclical Model. Data was collected using the mixed-method triangulation technique, which resulted in the use of three research instruments: an interview guide (FGD), a worksheet score, and observation notes. These data were examined using thematic (qualitative) and statistical analysis (quantitative). The results of the study revealed that using CoMon AProCh increased the student's scores dramatically from 4.09 to 7.44. This difference was tested for significance using the paired T-test and yielded a t-test value of 14.06 with a corresponding p-value of 1.776e-15, indicating that there is a significant difference between the scores. These findings corroborated the students' insight on the use of intervention, implying that the intervention addressed the students' difficulties with integer addition and subtraction. It is recommended that teachers examine and investigate the difficulties that students face, as well as broaden the strategies that provide new learning opportunities for students who struggle with number problems.

Keywords: Experimental-Descriptive; Integer Addition and Subtraction; Mathematics

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As the saying goes, "No one achieves success without acknowledging the assistance of others." The wise and confident gratefully acknowledge this assistance. It is only right and proper that these people be given the extra credit that they truly deserve.

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Thank you for your indulgent words of encouragement to the participants of this study, who have spared ample time and patience in the pursuit of this action research, to our School Head, Ma'am Meriam Endoy, and to all the teachers and staff of Balukbahan National High School, and to my entire family.

Thank You, Most High Father God, for the sufficiency You have bestowed throughout the duration of this toil. This research paper is my way of thanking You and praising Your holy name.

- Lowell

Zamboanga Peninsula

Context and Rationale

Learning addition and subtraction of integers is necessary in understanding the concepts of algebra, trigonometry, calculus, or any Mathematics topic. Students, as they move one grade higher every year are expected to work with signed quantities or integers, both negative and positive values. First-year algebra is considered the doorway to higher mathematics by many math educators, and integer arithmetic is a crucial area of study in algebra. (Bolyard and Moyer-Packenham 2012, 93-113).

Gallardo (2002, 171-192) noted that despite the increased emphasis, students' difficulties with algebraic concepts are partly due to their inability to comprehend and manipulate negative numbers. International assessment studies have shown that students have problems with integer operations, particularly with integer subtraction (Lytle 1992).

Consequently, learning addition and subtraction of integers is provocative before pandemic and even until the schools transitioned to modular distance learning. On a report conducted by Programme for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD 2019), the average score in mathematical literacy for Filipino pupils, according to the statistics, was 353, which places them second to bottom globally. This is categorized as below Level 1 proficiency and much lower than the OECD average (489 points). This means that students are limited to answering questions in easily understood contexts in which all pertinent information is provided in a clear, recognizable style (such as a small table or picture) and explained in a brief text with a simple grammatical structure.

On a statement released by the Department of Education (DepEd) on December 4, 2019, they agreed that the PISA results also show how well students performed on the National Achievement Test and that DepEd understands how urgent it is to close gaps and address problems in the Philippines' pursuit of high-quality basic education.

These results were also consistent in the National Achievement Test results in the Philippines for the school year 2017-2018. For Grade 6, Mathematics mean percentage score (MPS) is 36.85%, while Grade 10, 34.26% which were below 75% set as the goal of the Department of Education (DepEd).

In the school year 2021-2022, the Division of Zamboanga del Sur tallied an MPS of 58.67% in Mathematics for Grades 4 to 6, as revealed in the baseline data of the School Improvement Plan (SIP).

These circumstances are also apparent in the performance of Grade 7 students of Balukbahan National High School, Bayog District as it obtained an average mean of 4.08 in a 10-item Mathematics assessment for 1st Quarter on the learning competency about the fundamental operations on integers particularly on integer addition and subtraction. The teacher-researcher is alarmed with these results since knowledge on the operations on integers is essential in understanding higher Mathematics concepts.

This inspired the proponent to conduct action research that boosts the knowledge and skills of students in adding and subtracting integers using the **Co**ntextualized **Mon**ey **A**nalogy **Pro**cedural **Ch**ecklist (CoMon AProCh) as an intervention.

Innovation, Intervention and Strategy

Contextualized **Mon**ey **A**nalogy **Pro**cedural **Ch**ecklist (CoMon AProCh) is the researcher's intervention in boosting the student's integer addition and subtraction skills. It is a contextualized procedural checklist with the use of money analogy

(money and debt) that will guide the students in answering integer addition and subtraction worksheets.

The intervention followed Rios and Chiu's (2019) procedural checklist definition. They described a procedural checklist in their study as a list of particular actions that participants had to follow in order to successfully solve problems on the arithmetic worksheets. Wyatt (2015, 111-132) contrasts this with the idea that contextualization is pervasive according to research on teaching linguistically and culturally diverse groups, teachers need to get familiar with their students in order to tailor their lessons.

Taken together, the researcher has come up with a Contextualized Money Analogy Procedural Checklist (CoMon AProCh) intervention template (see Figure 1) as guide for students in performing integer addition and subtraction *[M7NS-ld-2]* worksheet.

Figure 1: *CoMon AProCh Template*

Procedural Checklist on Integer Addition and Subtraction
Fill the data needed in each step. Pun-a ang datos nga gikinahanglan sa matag lakang

☐ **Step 1:** Write the given. Isulat ang gihatag.

☐ **Step 2:** Remove parenthesis, if any. Kuhaa ang parentesis, kon aduna.

☐ **Step 3:** Change + + and − − to + / Change + − and − + to −
Ilisdi ang + + ug − − sa + / Ilisdi ang + − ug − + sa −

☐ **Step 4:** Think that a positive integer as your money then write how much money you have below.
Hunahunaa ang positive integer isip imong kuwarta dayon isulat kung pila ang imong kuwarta sa ubos.

☐ **Step 5:** Think that a negative number as your debt then write how much debt you have below.
Hunahunaa ang negative integer isip imong utang unya isulat kung pila ang imong utang sa ubos.

☐ **Step 6:** If you will pay all your debt using your money, how much do you have left?
Kung bayran nimo ang tanan nimong utang gamit ang imong kuwarta, pila ang imong nahabilin?

Note. *Step 6 is your final answer. Ang step 6 mao ang tubag.*

Action Research Questions

The purpose of this action research study is to boost the integer addition and subtraction skills of Grade 7 Balukbahan National High School students using CoMon AProCh as an intervention in the school year 2022-2023.

Specifically, this study answered the following questions:

1. What are the difficulties encountered by the students on integer addition and subtraction?

2. What are the students' integer addition and subtraction scores using the CoMon AProCh?
3. Is there a significant difference between the students' scores in addition and subtraction worksheets before and after the intervention?
4. What is the student's insight on the use of CoMon AProCh?

Action Research Methods

Research Design

The study used an experimental-descriptive research methodology based on Hendricks' Action Research Cyclical Model. Hendricks observed that her model, which is grounded in a classroom setting, places a strong emphasis on acting, evaluating, and reflecting. The study used a variety of methods for gathering and analyzing data. A mixed method study (Creswell 1999, 455–472) collects and analyzes data using qualitative and quantitative methodologies.

Participants and/or other Sources of Data and Information

The action research study was implemented at Balukbahan National High School, Bayog District. This research employed a purposive sampling technique, which was applied to the selected Grade 7 Oro students. They were the main participants of the study because they have the lowest scores in integer addition and subtraction worksheets, among other sections. Purposive sampling, such as judgement and quota, is a method in which participants meet predetermined standards for inclusion (Sibona and Walczak 2012, 3510-3519).

Table 1: Participants of the Study

Characteristics	Values	f	%
Sex	Male	22	64.71
	Female	12	35.29
Total		34	100.00

Research Instruments

In determining the problems encountered by the students on integer addition and subtraction (research question 1) and their insight on the use of CoMon AProCh (research question 4), the researcher used an interview guide. The gathered interview responses were validated using a Focus Group Discussion (FGD) facilitated by the researcher together with the 10 participants. A focus group typically consists of 8 to 12 people who discuss a specific subject under the guidance of a trained moderator who encourages interaction and ensures that the conversation stays on the subject at hand (Stewart and Shamdasani 1998).

Integer addition and subtraction worksheet was utilized in determining the student's score (questions 2 and 3).

Data Gathering Procedure

Reflect. The teacher-researcher was alarmed by the scores of the students as they obtained an average mean of 4.08 in a 10-item Mathematics worksheet for 1st

Quarter on the learning competency about the fundamental operations on integers, particularly on integer addition and subtraction.

Act. The scenario necessitated the researcher devising a new technique to improve the students' grades. The researcher interviewed these students to determine why their grades were so low. As an intervention, the researcher created a contextualized procedural checklist template based on the students' responses. The template includes the necessary procedures in vernacular, including the use of money as a positive integer and debt as a negative integer. The teacher-researcher thoroughly discussed these procedures.

Evaluate. The teacher-researcher conducted another assessment after implementing the intervention, and the results were positive. This prompted the researcher to re-interview the students and solicit their feedback on the intervention's effectiveness.

To guarantee optimal study execution, the research instruments utilized in this inquiry underwent quality assurance inspection by professionals. The study underwent quality assurance by experts to ensure maximum implementation. A consent letter was sent to the study participants, and their participation was voluntary. Additionally, the information that was recorded, scored and tallied throughout the interviews always remained private.

Data Analysis

Following the mixed methods in analyzing the data of the study, the researcher utilized both qualitative (interview responses) and quantitative (score) analysis. All the responses (before and after the intervention) gathered in the interview questions that were validated using FGD were analyzed using manual thematic analysis. A technique called "thematic analysis" is used to find, examine, and interpret meaningful patterns, or "themes," in qualitative data (Braun et al. 2014, 1947-1952).

The scores from the integer addition and subtraction worksheet were analyzed using descriptive statistics such as percentage, graph, mean, and standard deviation. In determining the significant difference between the pre and post-test scores, the concept of a Paired T-test was used.

All of these statistical studies were created using Microsoft Excel and the R-Program.

Results and Discussion

The study's findings were presented in this section, which included tables, graphs, and interpretations. Inclusions of relevant literature from credible sources were also mentioned to support the study's findings.

Difficulties Encountered by the Students on Integer Addition and Subtraction

The data in the table were categorized using manual thematic analysis, which facilitated Focus Group Discussion supplemented. The study uncovered three emerging themes: lack of interest, short attention span, and processing problems.

Table 2: Results of Manual Thematic Analysis

Themes	Category	Sample Quotes	Frequency
Lack of Interest	The participant stated that he doesn't enjoy Math.	"I don't get excited about numbers."	11
Short Attention Span	The participant became bored as more concepts were introduced.	"I can't concentrate because there is so much information."	8
Processing Problems	The participant became confused about the next step.	"I forgot the what to do next."	15
Total			34

Table 2 shows that among the themes mentioned, ***"Processing Problems"*** had the highest frequency (15 responses). The frequency under ***"Lack of Interest"*** recorded 11 responses, indicating that the participant does not enjoy Math. In the ***"Short Attention Span"*** theme, 8 participants stated that they are unable to concentrate due to information overload.

Student's Integer Addition and Subtraction Scores

Figure 2: Pretest and Post-test Mean Scores

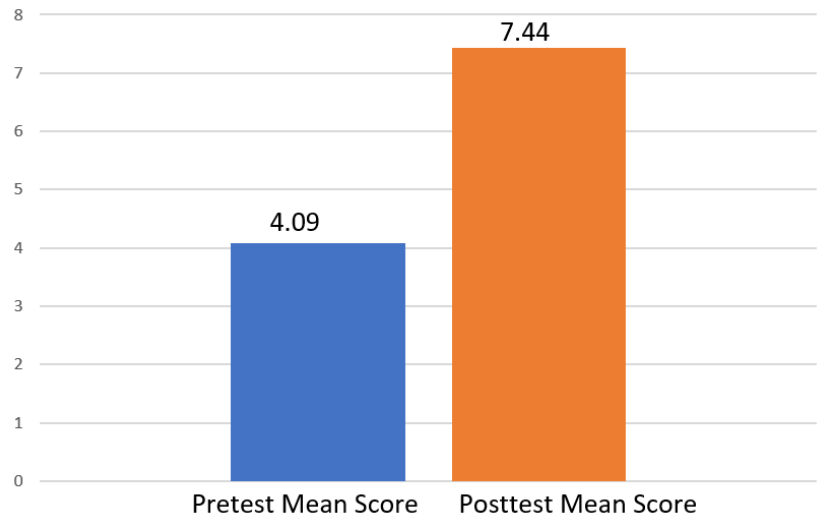

Figure 2 depicts the means of the students' pretest and posttest scores on the integer addition and subtraction worksheet. The scores increased dramatically from 4.09 to 7.44, with a mean difference of 3.35, indicating that the intervention was effective.

Significant Difference on Pretest and Post-test Scores

Table 3: Relationship Between the Pretest and Post-test Scores

Parameter	Pretest	Post-test
Sample n	34	34
Mean	4.09	7.44
Mean Difference	3.35	
Standard Deviation (Difference)	1.39	
Computed T-test Value	14.06	
Degree of Freedom	33	
p-value (two-tailed)	1.776e-15	
Significance Level **α**	0.05	
Decision	Reject H_o, since 0.00001 < 0.05	
Interpretation	With Significant Difference	

The relationship between the scores of Grade 7 students before and after the intervention is depicted in Table 3. The paired t-test concept was used to determine whether the mean difference is significant. The corresponding p-value in two-tailed hypothesis testing is 1.776e-15, using the computed T-test value of 14.06, the level of significance 0.05, and the degrees of freedom 33. The p-value was less than 0.05, indicating that the pretest and post-test scores differed significantly. This implies that the difference in outcomes was not due to chance. Other variables could have been at play. The students may have been properly positioned for the post-test. One factor could be that the intervention produces positive results.

Student's Insight on the Use of CoMon AProCh

When asked about the impact of the intervention, one student stated that the template piqued his interest because it involved money. And learning integer addition and subtraction could be beneficial to him in the future. Another student stated that the template does not contain excessive information. Another student mentioned that all of the procedures were written thoroughly, which helped him to know what to do next. These responses clearly addressed the students' difficulties with integer addition and subtraction. It was also evident in their results, which showed improvement. As a result, the CoMon AProCh is essentially a knowledge booster intervention for students' integer addition and subtraction skills.

Conclusion and Recommendations

The contextualized money analogy procedural checklist intervention improved students' understanding of integer addition and subtraction, as shown in this study. The template explained how to solve signed numbers on their own. The checklist also served as a guide when they were unsure what to do next. Students were able to realize the importance of learning how to add and subtract integers through the

checklist. As a result, the CoMon AProCh intervention improved students' integer addition and subtraction skills gradually.

Based on the researcher's reflections and conclusions drawn from the study's results and findings, the suggestions that follow are made:

1. Teachers may not limit their teaching strategy to what is contained in the learning material. The use of a contextualized money analogy procedural checklist as an intervention provides new learning opportunities for students who struggle with number problems. Through strategic planning and implementation, they can examine and address these limitations.
2. Students may be considered in the conception and development of learning materials that support their personality and preferred learning style by allowing students to share their insights and learning needs.
3. School administrators may continue to expose teachers to various types of training through LAC sessions in order to help them become more adaptable in using appropriate teaching methodologies that are more adaptable to learners.

Action Plan

Goals/ Objectives	Activities/ Strategies	Persons Involved	Resources Needed	Time Frame	Success Indicator
To utilize and disseminate Contextualized Money Analogy Procedural Checklist as an intervention in boosting students' integer addition and subtraction skills.					
Secure LAC Activity Plan in the district and division	Prepare LAC Activity Plan signed by the proper signatories	Teacher, Researchers, CID Officials	Bond paper, printer ink	August-September	LAC Plan
Conduct school-based INSET and SLAC session	Introduce CoMon AProCh in teacher's meeting and SLAC session	Teachers, School Head	Bond Paper, Printer ink, Meals and Snacks	August-September	Activity Completion Report
Conduct HRPTA meetings to discuss problems in integer addition and subtraction	Discuss with parents the importance and plans of addition and subtraction of integers	Teacher, Parents	Bond paper, printer ink	August-September	Attendance Sheet, minutes of meeting, action plan and memo
Implement the CoMon AProCh intervention to students	Discuss the procedural checklist and money analogy in the classroom	Teacher, Students	School Supplies	September-October	Formative Test and Performance Tasks Outputs
Monitoring the implementation of CoMon AProCh intervention	Check student's learning outputs	Teacher, Students	School Supplies	October-November	Formative Test and Performance Task Output, Class Record
Evaluating performance and/or improvement	Use of graphs	Teacher	Supplies	November 2022	Formative Test and Performance Task Scores, Class Record

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Financial Report

Activities	Quantity	Unit	Estimated cost	Total estimated cost
SUPPLIES AND MATERIALS				
A4 Bond Paper	2	ream	280	560
Epson printer ink cyan	1	refill bottle	375	375
Epson printer ink yellow	1	refill bottle	375	375
Epson printer ink magenta	2	refill bottle	375	375
Epson printer ink black	5	refill bottle	375	750
Long Folder	5	piece		40
Fastener	5	piece		25
WiFi Load	10	Weekly promo	100	1000
			SUBTOTAL:	3500
Reproduction and Binding cost				
Binding of documents	5	instance	40	200
			SUBTOTAL:	200
			GRAND TOTAL:	**₱3,700.00**

Appendix A

Interview Guide

I – Introduction

A. Greetings
   - Introduce yourself to the participants.
   - Explain to the participant that you are doing action research to boost student's integer addition and subtraction skills using an intervention.
   - For the research, you will be asking them questions about the problems encountered in integer skills (before implementation) and their insight (after intervention) on the use of the intervention.

B. Confidentiality
   - All information collected during this research will be kept safe and secret.

C. Study identifiers
   - You will not use their names or any other identifying information, and everything that they say will be used for research purposes only.

II – Interview Guide

1. How are you doing today?
2. Perceptions/Preferences

   Before implementation of the intervention:

   - Ask questions about specific experiences of the modular learning that they encountered in answering integer addition and subtraction worksheets.
   - Ask them how they study the integer concepts before answering the integer worksheet.
   - Ask them for their suggestions on effectively delivering the concept given the pandemic situation.
   - Ask them what else the teacher can do to help them improve their integer arithmetic skills.
   - Always prepare follow-up questions depending on their answer.

   After implementation of the intervention:

   - Ask them how the intervention helped them clarify solving integer addition and subtraction worksheets.
   - Ask them the memorable thing they recall after using the intervention.
   - Ask them about how the intervention do better than the usual.
   - Ask them if they were able to learn the information from the intervention as well as they would have in a face-to-face classroom setting.
   - Always prepare a follow-up question depending on their answer.

III –Notes

Record and transcribe all their responses on the observation notes.

Appendix B

Observation Notes

Initial Questions:

1. _____?

Possible Answer:

_____

_____

2._____?

Possible Answer:

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Appendix C

Contextualized Money Analogy Procedural Checklist Template

Procedural Checklist on Integer Addition and Subtraction
Fill the data needed in each step. Pun-a ang datos nga gikinahanglan sa matag lakang

☐ **Step 1:** Write the given. Isulat ang gihatag.

☐ **Step 2:** Remove parenthesis, if any. Kuhaa ang parentesis, kon aduna.

☐ **Step 3:** Change + + and − − to + / Change + − and − + to −
Ilisdi ang + + ug − − sa + / Ilisdi ang + − ug − + sa −

☐ **Step 4:** Think that a positive integer as your money then write how much money you have below.
Hunahunaa ang positive integer isip imong kuwarta dayon isulat kung pila ang imong kuwarta sa ubos.

☐ **Step 5:** Think that a negative number as your debt then write how much debt you have below.
Hunahunaa ang negative integer isip imong utang unya isulat kung pila ang imong utang sa ubos.

☐ **Step 6:** If you will pay all your debt using your money, how much do you have left?
Kung bayran nimo ang tanan nimong utang gamit ang imong kuwarta, pila ang imong nahabilin?

***Note**. Step 6 is your final answer. Ang step 6 mao ang tubag.*

Appendix D

Integer Addition and Subtraction Worksheet

Name: _____ Score:_____

Grade and Section:_____ Date:_____

Instruction: Find the sum and difference.

1. 3 + (−7) =

2. (−5) + 8 =

3. (−5) + (−5) + 1 =

4. (−9) + 4 + 7 =

5. 3 + (−10) + 6 =

6 .- 6 – 5 =

7. 3 – 8 =

8 . (−7) − (−7) – 4 =

9. (−8) − (−8) – 5 =

10. 6 − (−3) – 1 =

Consent Form

Research Title CoMon AProCh: A Knowledge Booster Intervention for Student's Integer Addition and Subtraction Skills (Contextualized Money Analogy Procedural Checklist)

Please read and complete the table by writing check mark (✓) on the second column.

1. I attest that I have read and understand the information about the research conducted by the proponent.	
2. I had the opportunity to consider the information and ask questions specifically.	
3. I confirm that my participation in this study is voluntary wherein I can withdraw any time I want without giving reasons for withdrawal.	
4. I am aware that my name will not be reflected on the presentation of the results of the study.	
5. I give permission to the lead proponent to be able to access my academic records that are relevant to this research.	
6. I agree to take part on the above study.	

Participant:

_____ _____ _____

Name of Parent/Guardian Signature Date

Researcher:

Lowell B. Dela Peña _____ _____

Name of Researcher Signature Date