

Lower Grade Level Group

<< Theme of the Research >>

Instruction that Helps Students Eagerly Grapple with Mathematics!
-- Aiming to Improve Students' Expressive Abilities --

1. Students' State of Learning:

- A number of students want to solve problems on their own using and enhancing the knowledge they learned previously.
- Students are developing note-taking skills gradually.
- △ Students are still not accustomed to writing their thinking/ideas.
- △ Even when students write their mathematical thinking/ideas, their explanations are often insufficient.

2. Goal for An Image of Students:

- Students willingly and enthusiastically write their own mathematical thinking/ideas in their notebooks and explain their thinking/ideas to others.
- Students use what they have learned previously in math class and describe and explain their thinking/ideas to others.

3. Instructional Ideas for Improvement:

Ideas for Helping Students' Eagerly Grapple with Mathematics
<ul style="list-style-type: none"> • Provide problem situations that are familiar to the students • Use instructional materials that help students become interested in visual representations, such as using real objects, illustrations, photos and/or PowerPoint presentations. Support students as they show an increasing willingness for problem solving, expressing their interest by making statement, such as, "I want to find a solution to this problem/task!"
Ideas for Improving Students' Expressive Ability
<ul style="list-style-type: none"> • Expand student's thinking and reasoning via problem solving situations where students engage in making transition from concrete materials and illustrations to diagrams, and from diagrams to mathematical expressions and words (explanations). • Teach students how to carry out mathematical conversations and discussions in math classrooms. Expand students' explanation skills in pairs, small groups, and eventually whole class.

4. Grade 2, Name of the Unit: Subtraction with an Algorithm

5. Focal points of this lesson; i.e., points that we want to discuss during the post-lesson discussion.

Focal Point 1: Was the setting and launch effective in generating and making evident students' eagerness to engage in problem solving?

Focal Point 2: Was asking students to use the block or cherry diagrams an effective way to draw out students' thinking about regrouping?

Grade 2, Mathematics Lesson Plan

Date & Time: 5th period, Wednesday, June 18, 2014

Class: Grade 2, Class No. 3 (31 Students)

Instructor: Haruka Miyamoto

1. Name of the Unit: Subtraction Algorithm

2. Goals of the Unit:

- Help students deepen their understanding of subtraction and develop their ability to utilize subtraction.
- Help students understand the bidirectional (inverse) relationship between addition and subtraction and foster their ability to explain this relationship using math expressions.

3. Evaluation Standards:

Interest, Eagerness, and Attitude [IEA]	Mathematical Way of Thinking [MT]	Mathematical Skills [MS] on Quantities and Geometric Figures	Knowledge and Understanding [KU] on Quantities and Geometric Figures
<ul style="list-style-type: none"> • Students are eager to think about how to calculate subtraction of 2-digit numbers. • Students are eager to utilize subtraction of 2-digit numbers in their lives and for learning. 	<ul style="list-style-type: none"> • Students think about how to calculate subtraction of 2-digit numbers. • Students are investigating the property of subtraction, thinking about how to calculate using it, and utilizing the property as a method to check calculated answers. 	<ul style="list-style-type: none"> • Students are able to confidently calculate subtraction of 2-digit numbers, by understanding the procedure of algorithm calculation. 	<ul style="list-style-type: none"> • Students understand that subtraction calculations of 2-digit numbers consists of basic calculations of 1-digit numbers, by utilizing the place value of digits in numbers. • Students understand how to calculate subtraction of 2-digit numbers.

4. Three Pillars of Instructional Material:

(1) Our view of the instructional material:

The goals of the unit are for the students to think about the process of subtraction calculations using the algorithm and applying these calculation skills to solve problems. In addition, students will be able to grasp the relationship between addition and subtraction and be able to express the meaning of addition and subtraction using tape diagrams.

The students learned in the previous unit how to use the algorithm to add 2-digit numbers with regrouping by aligning each place value. In this unit students learn the more complicated calculation process of 2-digit subtraction with regrouping, i.e., 2-digit minus 2-digit or minus 1-digit numbers that involve regrouping.

We would like to foster students' disposition for solving problems on their own and thinking about better ways to explain their ideas clearly to others, through discussing how they manipulate blocks and utilize cherry diagrams. Through such discussions, we want to help students understand the meaning of

calculation involving regrouping, when a 10 is decomposed before finishing the calculation process. Lastly, we would like to help students be able to do the calculations confidently by practicing after they deeply understand the process and meaning of subtraction calculations with the algorithm.

(2) Students' expressive ability that we would like to foster in this unit:

◎ What and how students express their thinking:

- Students utilize the knowledge they learned previously

Student express their process of thinking by drawing the block or cherry diagrams and making connections with what they learned in previous lessons, such as regrouping calculations in Grade 1 and 2-digit addition regrouping calculations in a previous Grade 2 unit. For students needing more support, encourage them to use blocks to express and represent the process of their thinking and reasoning.

◎ Mathematics students need to express

- Students express the process of algorithm calculation.

Students understand that the process of regrouping in subtraction, "break a group of 10 into 10 single ones," is the same regardless of whether they use the block or the cherry diagrams to express the process. By doing so, students realize the merit of the base ten system and understand that even as the number of digits/places increases, the calculations used in each place is as simple as the calculations they learned in Grade 1, such as: 1-digit minus 1-digit numbers without regrouping and 2-digit (teen numbers) minus 1-digit numbers with regrouping calculations.

(3) Evaluation during the lessons:

★ Evaluation during the time students solve a problem on their own:

Are the students trying to come up with ideas for how to calculate subtraction with the algorithm and apply the calculation process?

Level A: Students are trying to regroup one (1) from the tens place to make 10 ones by using block and/or cherry diagrams and writing the explanation of their thinking process in words.

Level B: Students are trying to solve the calculation by using block and/or cherry diagrams, and writing the explanation of the process in words.

★ Evaluation during the time students engage in whole class discussion:

Level A: Based on their diagrams (e.g., block and cherry diagrams), students are able to present their ideas for regrouping one (1) from the tens place to make 10 ones and explain what they've written in their notebooks. Furthermore, they grasp the similarities and differences between their own ideas and their classmates' ideas.

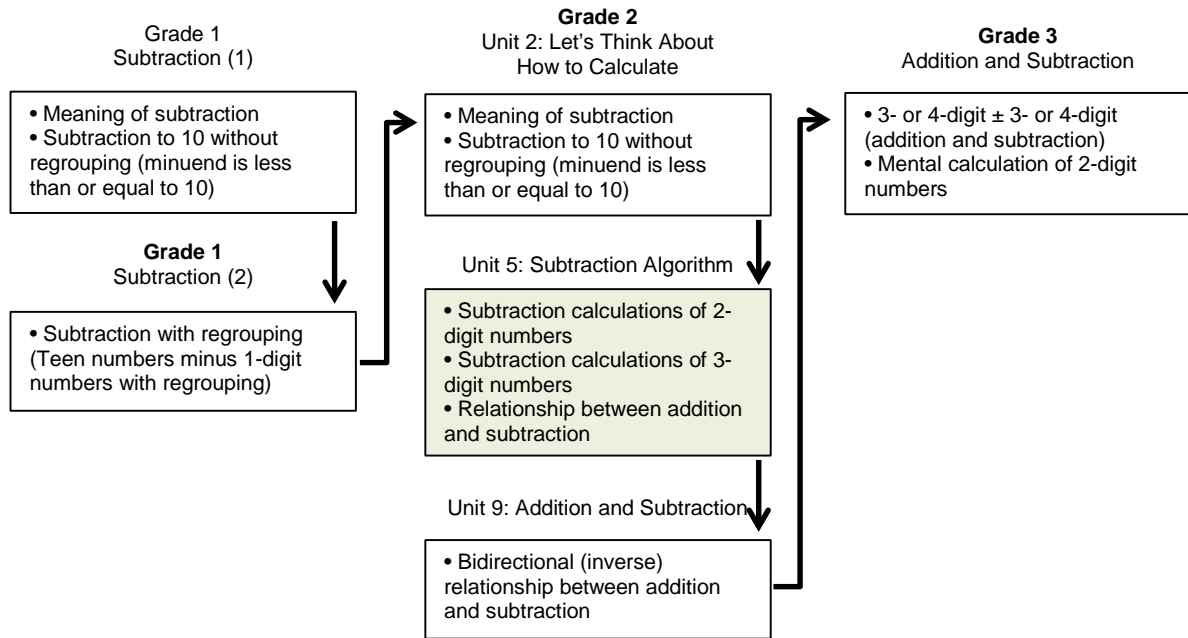
Level B: Students are able to present their ideas for regrouping one (1) from the tens place to make 10 ones, based on diagrams such as block or cherry diagrams. They explain what they have written and diagrammed in their notebooks.

★ Student's reflection about their learning from the calculation work recorded in their notebooks:

Level A: Students understand the meaning of regrouping from the tens place by comparing their own ideas and their friends' ideas and by grasping the similarities and differences among these ideas.

Level B: Students are able to understand the meaning of regrouping.

5. Scope and Sequence of Subtraction



6. About Instruction:

Devise the plan of the lesson

Utilize concrete materials corresponding to individual needs

○ Instructional Plan:

The suggested plan of this lesson is for students to think about how to calculate 45 minus 27 (45-27) and discuss the algorithm calculation. However, we want to stress that when students are expressing their own thinking, we decided not to include discussion of the algorithm calculation. Instead, we would like to provide more opportunities for students to present their own ideas in front of the class. In regard to the subsequent lesson, we plan first for students to summarize the learning from this lesson, and then engage in discussing the process of algorithm calculation.

○ Instructional that corresponds to individual student needs:

For students who struggle to write their own thinking easily, we will provide blocks and ask them to manipulate the blocks to represent the story problem. When the students need to regroup one (1) ten in the tens place into 10 ones in the ones place, we plan to help them understand how a ten-group of blocks in the tens place can be broken/decomposed into 10 individual ones in the ones place. Furthermore, during the whole class discussion, students will be asked to use blocks and to manipulate them to show the regrouping process. This process will

be repeated many times to help students understand the process deeply. Through this process of discussion, I hope that the students notice and conclude that “if we start calculating from the tens place, we might make a calculation mistake or run into difficulty.”

7. Students’ State of Learning:

In my class, there are students who think they are not good at mathematics or capable of being successful as strong mathematics learners. Moreover, there is a large gap in the speed with which my students solve problems and write down their thinking in their math notebooks. There are some students who can explain their own thinking clearly to others, but generally there are more students who do not have confidence in their ability to explain their thinking to others. They think and judge that they are not “good at it” (math).

For the addition algorithm calculations that students learned in the previous unit, some of the students could recall what they learned in the last year and utilize it to reason through the calculation process in this unit. Many of them understood calculation could be done by splitting tens and ones and then conducting calculations separately on each respective place value. There are some students who can compare the presented ideas and find the similarities and differences among them. However, there are some students who cannot describe the calculation process and are not yet able to express their own ideas in words or diagrams.

8. Unit and Evaluation Plan:

Sub-Units	Lesson	Content	Interest, Engagement, and Attitude	Mathematical Way of Thinking	Mathematical Skills	Knowledge and Understanding
Subtraction with 2-digit numbers	1	<ul style="list-style-type: none"> Understand problem situations that are applicable to subtraction and establish math expressions Think about how to calculate 2-digit – 2-digit without regrouping using the algorithm based on the knowledge gained from addition algorithm calculations. Think about the process of algorithm calculation by corresponding to how blocks are manipulated. Think about how to calculate 2-digit numbers minus tens and 2-digit minus 1-digit numbers Practice how to write and calculate using the algorithm. 		<ul style="list-style-type: none"> Through analogical thinking, consider how the format of the subtraction algorithm can be constructed in a similar way to the addition algorithm. 		<ul style="list-style-type: none"> Students understand the subtraction problem situation, meaning of subtraction, and how to calculate subtraction.
	2*	<ul style="list-style-type: none"> Find the difference between algorithm calculations with and without regrouping. Think about the calculation process by understanding the meaning of regrouping and by utilizing the block diagram and cherry diagram. 	<ul style="list-style-type: none"> Students are eager to think about the process of calculation by drawing block or cherry diagrams and writing explanations in words. 	<ul style="list-style-type: none"> Students are thinking in an organized way about the process of regrouping by corresponding regrouping to the block and cherry diagrams. 		

This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.

To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/>

	3	<ul style="list-style-type: none"> Understand how to calculate subtraction algorithm calculations with regrouping. Practice subtraction algorithm calculations with regrouping. Think about how to deal with zero (0) and a vacant place by applying algorithm calculations, such as $70 - 23$ and $34 - 26$. 			<ul style="list-style-type: none"> Be able to do the algorithm calculations such as tens minus 2-digit numbers and the difference of 2-digit minus 2-digit numbers that become a 1-digit number. 	
	4	<ul style="list-style-type: none"> Think about how to calculate 2-digit minus 1-digit algorithm calculations with regrouping. 			<ul style="list-style-type: none"> Be able to do subtraction algorithm calculations of 2-digit - 1-digit 	
	Practice	<ul style="list-style-type: none"> Deepen the understanding of the content learned in this unit. 			<ul style="list-style-type: none"> Be able to do subtraction algorithm calculations with regrouping 	
Subtraction that involves a minuend of more than 100	5	<ul style="list-style-type: none"> Think about the calculation process that splits the minuend in order to calculate easily and utilize calculation that is based unit of tens. Think about how to manipulate blocks to calculate the algorithm calculation involving regrouping from the hundreds place to the tens place. 		<ul style="list-style-type: none"> Students notice the regrouping calculation process from the hundreds place to the tens place is similar to the regrouping process of tens place to the ones place and are able to think and express the process using diagrams and math expressions. 		
	6	<ul style="list-style-type: none"> Think about calculation process of algorithm calculation involving two regrouping (the hundreds place to the tens place, and the tens place to the ones place) by using block and Cherry diagrams. 		<ul style="list-style-type: none"> Students are thinking the process of calculation orderly by first regrouping the tens to the ones then regrouping the hundreds to the tens. 		
	7	<ul style="list-style-type: none"> Think about the process of algorithm calculation when the tens place of the minuend is a vacant place. 		<ul style="list-style-type: none"> Students are thinking about the calculation process by regrouping from the hundreds place and do use the new numbers in the tens place to do the regrouping calculation of the ones place when the tens place of the minuend is a vacant place. 		

Subtraction with 3-digit numbers (minuends)	8	<ul style="list-style-type: none"> Think about calculation for hundreds minus hundreds. Think about calculation for 1000 minus hundreds. 				<ul style="list-style-type: none"> Students understand that they can calculate easily by a hundred as a unit. Also they understand how to subtract hundreds from 1000.
	9	<ul style="list-style-type: none"> Think about how to calculate 3-digit minus 1- or 2-digit algorithm calculations and pay attention to the regrouping that is necessary during the calculations. 			<ul style="list-style-type: none"> Students are able to express 3-digit minus 1- or 2-digit calculations using the algorithm and carry out the calculation correctly. 	
Relationship between Addition and Subtraction	10	<ul style="list-style-type: none"> Investigate the relationship among minuend, subtrahend, and difference using the tape diagram and the word math sentence, and think about the relationship between addition and subtraction. Use addition to check the answers to subtraction problems. 				<ul style="list-style-type: none"> Students understand that subtraction is an inverse calculation (operation) of addition and addition can be used to check the answer of subtraction.
Which calculation should we use?	11	<ul style="list-style-type: none"> Grasp the relationships of quantities such as part + part = whole and whole - part = part using tape diagrams. Use mathematical expressions to represent these relationships 			<ul style="list-style-type: none"> Students are able to read the tape diagram and present it with it corresponding math sentence. 	<ul style="list-style-type: none"> Students understand the relationship between addition and subtraction as an inverse relationship.
Practice	12	<ul style="list-style-type: none"> Deepen understanding of the content studied in this unit 			<ul style="list-style-type: none"> Students are able to do calculations with the algorithm for 2-digit minus 2-digit and 3-digit minus 1- or 2-digit with or without regrouping. 	
Power Builder	13	<ul style="list-style-type: none"> Review and check the content studied in this unit. 				
		<ul style="list-style-type: none"> Understand the meaning of <i>Mushikuizan</i> (arithmetical restorations). Think about how to solve the problem by utilizing the mechanics of the algorithm learned previously. Students explain the solution process. 	<ul style="list-style-type: none"> Students show interest and motivation for calculations through problem solving with <i>Mushikuizan</i> problems. 			

* This Lesson

Goals of This Lesson:

Using diagrams and words, students are able to think about how to calculate by paying attention to calculations in each place value.

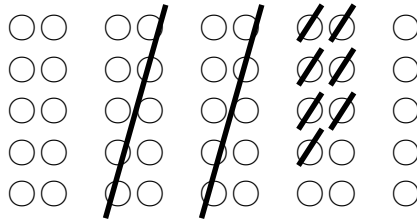
9. Flow of the Lesson (Lesson 2/13)

	<p>■ Learning Activities <i>Hatsumon</i> (T), Students' Anticipated Responses (C)</p>	<p>○ Points to Remember ◆ Evaluation ★ Support</p>
<p>Understand the Problem and Make a Plan for Solving the Problem</p>	<p>■ Understanding the Problem and Make a Plan for Solving the Problem</p> <p>T1: There were 45 tadpoles. 27 of them became frogs. How many tadpoles are left? T2: What is different about this problem from the one we worked on yesterday? C1: The numbers used in the problem are different. T3: Up until yesterday, how have we been calculating? C2: We calculate numbers keeping the tens and ones separate. T4: Okay, let's calculate this one by splitting up the tens and ones. Let's write the algorithm (vertical notation) on the board. For the tens place the calculation becomes 4 minus 2 (4 - 2) ... For the ones place the calculation becomes, 5 minus 7 (5 - 7) ... C3: We can't calculate this. C4: We can't subtract 7 from 5. This is different from the problems we worked on before. T5: What should we do?</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Let's think about how to calculate 45 - 27.</p> </div> <p>T6: Let's think about how to calculate this problem.</p>	<p>○ Show the slides of tadpoles and frogs and help students understand the problem. ★ Setting up a familiar topic as the problem situation (i.e., tadpoles in the biotope), brings out students' interest in the problem.</p> <p>○ Writing the algorithm on the board helps students understand visually how the numbers in the ones place cannot be subtracted easily.</p>

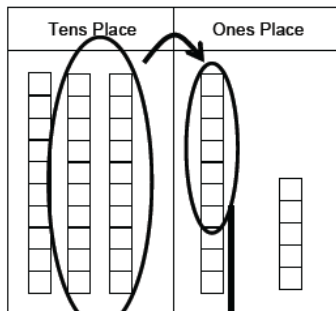
Student Solving the Problem on Their Own

■ Student Think about How to Calculate

② Draw circles with groups of 10s and subtract 27 from there.



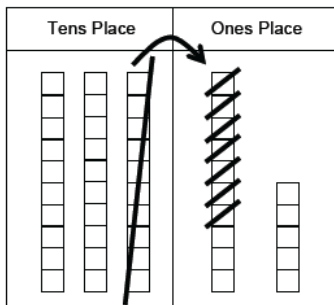
③ Think about the calculation using blocks. (A)



$$30 - 20 = 10 \quad 15 - 7 = 8$$

$$10 + 8 = 18$$

③ Think about the calculation using blocks. (B)



$$30 - 20 = 10 \quad 15 - 7 = 8$$

$$10 + 8 = 18$$

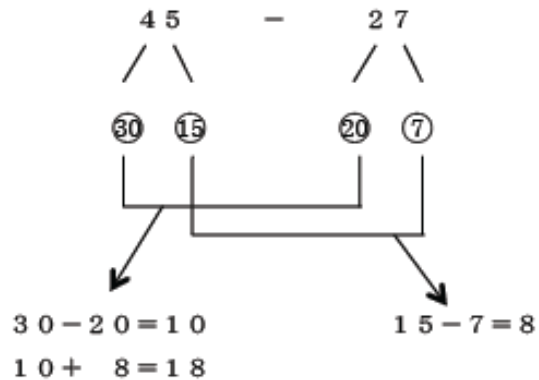
★ For students having difficulty coming up with their own ideas, provide blocks they can manipulate to represent the story problem as they work to understand the problem.

○ Help students to think about what they can do when they can't subtract numbers in the ones place. Help them notice and pay attention to how they can use the number in the tens place to solve not having enough ones (to subtract 7).

○ If students are drawing circles, suggest that they draw the circles organized into groups of tens.

★ [IEA] Students try to solve the problem by drawing block or cherry diagrams.

④ Think about the calculation using the Cherry Diagram



Answer: 18 tadpoles

Presenting and Discussing (Whole Class)	<p>■ Presenting Own Ideas</p> <p>T7: Let's present your own ideas.</p> <p>■ Finding Commonality of Ideas</p> <p>T8: When you compare the methods, do you see any commonality? C5: The calculations were done at each place separately. C6: Carry out subtraction in each place separately and added what was left in each place. C7: Moving 1 from the tens place and made 10 in the ones place. C8: Moving 1 from the tens place and calculated $15 - 7$. C9: Split 45 into 30 and 15 and carry out the calculation $15 - 7$, so it is also similar to other ways.</p>	<ul style="list-style-type: none"> ○ Ask students to draw their diagrams on paper and post them on the board. ○ Put blocks on the board and ask students to manipulate them. ○ Record student ideas and keywords on the board. <p>★ [MT] Students are able to present the process of calculation, breaking one (1 ten) in the tens place and showing the 10 in the ones place. Students do this by using the block and cherry diagrams they recorded in their math notebooks.</p>
Summarizing	<p>T9: This calculation process, moving 1 from the tens place and changing the 1 ten to 10 in the ones place, is called "regrouping." When we "regroup" we can use the calculation methods that we learned in Grade 1, can't we?</p> <p>■ Check the Ideas for the Calculation by Looking at the Slides of Tadpoles and Frogs</p> <p>T10: In the next lesson, let's represent the calculation process we discussed today using the algorithm.</p> <p>■ Writing Reflections</p>	<ul style="list-style-type: none"> ○ Ask students to check the ideas for the calculation by showing the slides of tadpoles and frogs. <p>★ [NU] Students are able to understand the meaning of the regrouping calculation process (moving a ten from the tens place to the ones place).</p>

10. Evaluation:

- Students are able to think about, represent, and explain how to calculate using diagrams, such as block cherry diagrams.

11. Board Plan:

Wednesday, June 18	Objective Let's think about how to calculate $45 - 27$!		
Problem	My Idea	Friends' Ideas	
There were 45 tadpoles. 27 of them became frogs. How many tadpoles are left?	Method ① Draw 45 circles and subtract 27 circles.	Method ② Draw 45 circles using groups of 10's. Take away circles from the 10's	Method ③ Thinking about the calculation using a block diagram.
Math Sentence: $45 - 27 = 18$	$\begin{array}{r} 45 \\ - 27 \\ \hline \end{array}$		
Answer: 18 tadpoles	$30 - 20 = 10 \quad 15 - 7 = 8$ $10 + 8 = 18$		
		Method ④ Thinking about the calculation using a cherry diagram.	<ul style="list-style-type: none"> • Calculations were done at each place value separately. • Results of calculations are added together. • Moving 1 from the tens place to make 10 in the ones place to calculate. • Splitting 45 into 30 and 15 then carrying out the calculation $15 - 7 = 8$.