Using Culturally Responsive Pedagogy to Promote Engagement and Learning
of Addition and Subtraction of Integers in Middle School Mathematics

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Abstract

The culture in which a student lives impacts the way they learn. It is important for mathematics teachers to be knowledgeable about students and their cultures to properly engage them in learning. Every classroom has a diverse set of learners that can benefit from the proper implementation of Culturally Responsive Pedagogy (CRP). Instructional tools that can develop and support CRP are Inquiry Based Learning, Authentic Questions, Modeling, and Hands-on Activities. This curriculum project presents these instructional tools designed around a 7th grade Integers unit to engage learners and develop a deeper understanding of the concepts.

Introduction

Differences across and within groups of students exist within the mathematics classroom such as race, gender, socioeconomic status, ethnicity, family dynamics, learning styles, and music preference…just to name a few. Embracing such differences, or similarities, and using them to support mathematics instruction can provide the opportunity to create a learning environment designed to support all students as learners. This is important as trends in mathematics education show that minority students, particularly black and Hispanic students, scored below their white peers in all mathematics content areas between 1973 and 1999 (Campbell, Hombo & Mazzeo, 2000). The achievement gap persists and calls for attention to be placed on the learning environment (Milner & Lomotey, 2013). To help close the achievement gap some educators have turned to Culturally Relevant Pedagogy (CRP). Milner and Lomotey (2013) stated that when students can own their culture in the classroom they develop meaning of material being taught, which helps them grasp the topic on a deeper level. Another important aspect of CRP is using tools that will increase engagement of the students (Ukpokodu, 2011). This curriculum project was designed using instructional practices that have been shown to support and engage all learners in the mathematics classroom. The lessons integrate inquiry-based learning, authentic questioning, modeling, and hands-on activities which come from both CRP practices and practices to increase student engagement (Milner, 2011; Marks, 2000). The content focus is on Adding and Subtracting Integers in 7th grade mathematics but the instructional practices can be applied to any grade level or subject.

Literature Review

Learning, as defined by cognitive load theory, is a permanent change in long term memory, meaning what was learned will be retained and can be recalled (Sweller, van

Merrienboer, & Paas, 1998). One method to support student learning is by getting to know them as students within the context of their unique culture. CRP entails teachers learning about the cultures in their classrooms and then using that knowledge to create a classroom environment, merged with instructional practices, that supports student learning (Rychly & Graves, 2012). Research has also shown that both minority and non-minority students tend to be disengaged in middle school (Marks, 2000). CRP has been shown to not only increase frequency, but increase quality, in student engagement (Milner & Lomotey, 2013). Using CRP to engage students in a meaningful way within the bounds of the curriculum that they are being taught has been shown to be beneficial to their overall mastery of the subject (Ukpokodu, 2011). Student engagement in the classroom has been shown to lead to academic achievement and increased social and cognitive development (Finn, 1993; Newmann, 1992). Additionally, students who are actively engaged in learning are more likely to comprehend the topic at hand and go on to pursue higher levels of education (Marks, 2000). Inquiry based learning, authentic questioning, modeling, and hands-on activities, which are expanded upon below, may be used to simultaneously increase student engagement and implement CRP practices in the classroom. (Milner, 2011; Marks, 2000).

Inquiry Based Learning

Inquiry Based Learning is designed to provide students with time to actively work on challenging problems (Rasmussen, Marrongelle & Hodge, 2017). This provides the students with both deep engagement in math and opportunities to collaborate with other students (Rasmussen, Marrongelle & Hodge, 2017). Students who participated in inquiry-based learning reported that they were more interested in what they were learning (Camenzuli & Buhagiar, 2014). It also gave students a deeper understanding of what they were learning and gave them a sense of

empowerment (Camenzuli & Buhagiar, 2014). Inquiry based learning promotes deeper engagement than an initiation-response-evaluation pattern, which involves asking questions that have an expected response (Rasmussen, Marrongelle, Kwon & Hodge, 2017).

Authentic Questions

Authentic questions can be described as mathematical problems and examples that relate to everyday life and their environments (Kaiser & Schwarz, 2010). Prior experience is said to be a building block to learning; every student brings a different attitude, experience and thus, perspective to the classroom (Torres-Velasquez & Lobo, 2005). It has been widely accepted that the use of authentic questioning in the mathematics classroom supports student understanding of how Mathematics relates to everyday life (Kaiser & Schwarz, 2010). The Common Core State Standards (CCSS) mathematics curriculum typically presents problems that are situational and designed to actively engage students in learning (Pandey, year). Students have stated that doing authentic problems are not only interesting to them but help them develop a deeper understanding of the concept being taught (Kaiser & Schwarz, 2010).

Modeling

Modeling can be described as a vehicle that provides students a basis for understanding specific mathematical concepts (Kaiser & Schwarz, 2010). An important consequence of mathematical modeling is the multiple solutions or multiple means to a solution, allowing students to develop their own understanding of a problem (Anhalt, Cortez & Bennett, 2018). It encourages students to persevere through a productive struggle, when they must use effort to make sense of a problem that does not have an obvious solution (Hiebert & Grouws, 2007). Modeling reality-based problems has become increasingly important (Julie & Mudaly, 2007). Students take authentic questions and translate them into equations, graphs, numeric tables, and

other mathematical models (Anhalt, Cortez & Bennett, 2018). Studies have found that when integers are represented as authentic questions, such as money, using different colored chips, a number line and other visual representations help students develop an imagery around integers and thus develop a deeper understanding of integers (AkyÃ, 2012).

Hands on Activities

Hands-on activities in the classroom engage students in a physical manner, such as manipulating materials or moving around the classroom (Bergin, 1999). They can enhance "out of the box" thinking skills in students and allow them to develop an understanding of the concept at their own pace (Raviv). Using hands on activities create a greater interest in the content; catching and holding the interest of students is key for students to learn and develop an appreciation for learning (Bergin, 1999).

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Curriculum

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Included in this curriculum are six lessons that integrate inquiry-based learning, authentic questioning, modeling, and hands-on activities into the instruction of integers with the goal of increasing student engagement. The materials and worksheets below are in the format that would be presented to students. Instructional keys provided for teachers are available in the appendix.

The Lessons

Lesson 1 "Introduction to Adding Integers" Topic: Adding integers using a number line	Key Components: -Guided Notes -Number line Game	CRP Tools: -Authentic Questions -Modeling -Hands on Activities
Lesson 2 "Adding Integers Practice" Topic: Adding integers using methods (no number line)	Key Components: -Guided notes -Adding War -Quiz	CRP Tools: -Hands on Activities
Lesson 3 "Introduction to Subtracting Integers"	Key Components: -Guided Notes	CRP Tools: -Authentic Questions

Topic: Subtracting integers using additive inverse (Keep, change, change)	-Quizizz Game -Exit Ticket	
Lesson 4 "Subtracting Integers Practice" Topic: Practice changing subtraction problems into addition problems and evaluating	Key Components: -Matching subtraction to addition activity	CRP Tools: -Modeling -Hands on Activities
Lesson 5 "Adding and subtracting integers" Topic: Using Addition and Subtraction in real life context	Key Components: -Financial Card activity -Quiz	CRP Tools: -Inquiry Based Learning -Authentic Questions -Hands on Activities
Lesson 6 "More Practice Adding and Subtracting Integers" Topic: More practice adding and subtracting integers	Key Components: -Volleyball Game	CRP Tools: -Hands on Activities

Lesson 1: Integration of Authentic Questioning

This lesson gives an introduction to adding integers. It starts by reviewing how positive and negative numbers are used in real life. It then goes on to use authentic questions (using topics such as temperature, elevation and money) and number lines to help students understand how to add positive and negative integers. Students are able to understand these problems as they are seen in everyday life. Students will then participate in a hands-on activity (game) where they roll dice and flip a "coin" and add the numbers. They are given a game board (a large number line) that allows them to engage in mathematical modeling. Presenting this content in a game-like format allows the students to be more and engaged and excited in the classroom, which then translates to an overall deeper understanding of the material.

Lesson Title: Introduction to Adding Integers

CCSS: NY-7.NS.1: Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers. Represent addition and subtraction on a horizontal or vertical number line.

Learning Target: I can add and subtract positive and negative integers using a number line by determining which direction on the number line to go.

Lesson Materials: Guided notes, game board (laminated number line), game pieces for each student, dice for every group of students, 2-sided (red and yellow) foam coin for each group of students.

Lesson 1 Outline:

Warm Up (5-10 minutes):

- Students come in and start warm up, on their own, for about 2-3 minutes

- Have students share their answers in partners or groups for about 2 minutes

- While students are discussing, walk around and check in on groups, making sure students have correct answers

- Ask for volunteers to share their answers, if no one is volunteering, call on specific people to answer (who you already know have answers)

- Ask students to defend why those examples are negative or positive.

Guided Notes (10-15 minutes):

- Ask students to take out their notebooks to take notes or print out guided note sheet to give to students

- Draw number lines for each problem

- Ask students guiding questions to help fill in the notes and solve the problems

Activity (20-30 minutes):

- Pair students up (one group of 3, if uneven)

- Have students collect materials from the front (One gameboard, game piece for each partner, 1 dice, 1 foam coin, a recording sheet for each group member)

- Read through activity directions to students

- Let them play the game

- Walk around and be sure students are recording all their turns on the recording sheet and doing their mathematics correctly

- When nearing the end of class have students put materials away and hand in recording sheets

Assessment: The activity tracking paper will be used as an informal assessment to demonstrate what students have learned that day. It can be graded on accuracy or as a check for understanding (completion). The most important questions students answer correctly are the last 2, move right when adding a positive and move left when adding a negative. If students are doing well, then a more challenging warm up can be given the next day. If not, spend time the next day going through a similar question and asking students guiding questions to reteach.

Lesson 1 Materials:

Warm Up:

> 1. Give an example of when positive integers are used in real life.
>
> 2. Give an example of when positive integers are used in real life.

Guided Notes

> Adding Integers
>
> 1. The temperature outside is -8 degrees at 6 a.m. and increases 14 degrees by noon. What is the temperature at noon?
>
>   When we add a positive number, we move _____ or _____ on the number line
>
> 2. A dolphin is swimming 5 feet below the surface of the water and swims down 10 feet. What is the final elevation of the dolphin, relative to the surface of the water?
>
>   When we add a negative number, we move _____ or _____ on the number line
>
> 3. Brianna owes her mom $3 and then borrows $6 more dollars. How much does she owe her mom now?

Activity Directions:

Each group member should put their game piece on zero. The player with the next birthday will start first. For each turn you will be adding a positive or negative number. On your Tracking Paper, record each turn. Flip the coin, if it lands on red that is negative, yellow is positive. Roll the dice, that is how far you will be moving. Be thinking about which way you need to move on the number line when you add a negative or a positive. The player with the largest end location at the end will win!

Tracking Paper:

Name:

(add more rows if you need to)

Addition problem	End location

Reflection questions:
1. What was your final end location? What was your partners?

2. Who won?

3. Which way do you move on the number line when adding a positive?

4. Which way do you move on the number line when adding a negative?

Activity "Game Board":

	10
	9
	8
	7
	6
	5
	4
	3
	2
	1
S T A R T	0 S T A R T
	-1
	-2
	-3
	-4
	-5
	-6
	-7
	-8
	-9
	-10

Lesson 2: Hands-on Learning Activities

This lesson teaches students to use absolute value to add numbers. Students will use specific methods to add numbers with same sign and numbers with different signs. Some students will find this easier, but some will still feel more comfortable with number lines. During the activity, encourage students to practice the methods learned in this lesson. This lesson is designed to be engaging by giving a hands-on activity where students compete against each other. The "adding war activity" will help students get better at doing the problems quickly and in their head, increasing fluency. Lastly, the quiz allows them to demonstrate their knowledge of adding with and without a number line.

Lesson Title: Adding Integers Practice

CCSS: NY-7.NS.1.B: Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
NY-7.NS.1.D: Apply properties of operations as strategies to add and subtract rational numbers.

Objectives: I can add and subtract positive and negative integers using the patterns and methods learned in class.

Lesson Materials: Playing Cards, Guided notes, quiz

Lesson 2 Outline:

Warm Up (5-10 minutes):

- Students come in and start warm up, on their own, for about 2-3 minutes

- Have students share their answers in partners or groups for about 2 minutes

- While students are discussing, walk around and check in on groups, making sure students have correct answers

- Ask students guiding and scaffolding questions to work through the problem together

Guided Notes (10-12 minutes):

- Ask students to take out their notebooks to take notes or print out guided note sheet to give to students

- Draw number lines for each problem

- Ask students guiding questions to help fill in the notes and solve the problems

Activity (10-15 minutes):

- Put students in pairs (or groups of 3)

- Give each group of students a deck of cards

- Read directions to students

- Keep guided notes up so that students can reference the methods

- Encourage students to take out paper to write down any problems they get stuck on

- Walk around and help students who are struggling

Quiz (5-10 minutes):

- Have students go back to desks

- Hand out quizzes and collect cards

- Have students hand in quizzes at the end of class

Assessment: The quiz is going to be graded for accuracy. Students will demonstrate their knowledge of adding positive and negative integers. The first question has them demonstrate their knowledge of using number lines. The second question allows them to demonstrate their knowledge of the methods learned in class. If students do well on the quiz, they are ready to move on to lesson 3. If students are still struggling then do some remedial work with them before moving on to lesson 3.

Lesson 2 Materials:

Warm Up:

Show all work for this warm up:

1. A climber is climbing above a cave. He starts 7 feet above the cave and then descends 12 feet. What is his new elevation relative to the entrance of the cave (0)?

Guided Notes:

> Adding without a number line
>
> When you add numbers with different signs...
>   1. Determine which number has the greater absolute value (Ignore the signs, figure out which number is bigger)
>   2. Take the sign of the number with the larger absolute value
>   3. Subtract the absolute values
>
>
> 1. The Bears are at the 15-yard line and they get pushed back 7 yards. What yard line are they at now?
>
>
>
>
> When you add numbers with the same sign…
>   1. Add the numbers together
>   2. Take the sign of the numbers
>
>
> 2. Nathan is playing a game. He lost 9 points and then lost another 5. What is his score now?

Activity Instructions:

> 1. I will assign you into partners/ groups of 3.
>
> 2. Red cards are negative, black cards are positive
>
> 3. Ace=1, Jack =11, Queen=12 and King= 13
>
> 4. Split the deck into equal amounts for each person in the group
>
> 5. Each flip your top card over and find the SUM of the 2 (or 3) cards. (If you need to, take a piece of paper out and do the problem on there)
>
> 6. The person who correctly determines the sum first wins and keeps those cards in a separate pile.
>
> 7. Repeat until all cards are gone
>
> 8. The person with the most cards at the end wins

Short Quiz:

Name:

Adding Integers Quiz

Directions: Please show all work!

1. Draw a **diagram** to represent the situation and **write** the elevation for each:
    a. A man is diving 31 feet below the surface of the water.

    b. There is a fish swimming 12 feet above him.

    c. There is a seahorse 5 feet below the fish.

    d. A duck is flying 26 feet above the seahorse.

2. Fernando started out February owing the bank $23, now his bank account looks like this:

Withdrawal	$20
Deposit	$17
Withdrawal	$13
Withdrawal	$8

    a. Use a number sentence to represent Fernando's bank account action using **addition**.

    b. How much does Fernando have in his account now?

Lesson 3: Authentic Questions during Practice

For this lesson, students must have the background knowledge or be pre-taught the concept of an additive inverse. It teaches students to use the additive inverse to change each subtraction problem into an addition problem. From there, students can use simple addition to complete the problem. In both the notes and practice for this lesson, authentic questions are used to connect students to the material. For practice, students will play the game Quizizz. For this game, it is best to have students partnered up and sitting together. This way they have the opportunity to engage in mathematical discourse. It is also a good idea to have students using individual whiteboards as this encourages them to show their work and gives them an easy way of communicating their thoughts. After all groups have finished the Quizizz game a winner will be declared. Prizes can also be given at the discretion of the teacher. When the game is over it will generate a list of most missed questions which can be reviewed with the students. Next, have students complete the exit ticket. This is a great way to have students not only share what they learned for today's material but also reflect on their overall learning.

Lesson Title: Introduction to Subtracting Integers

CCSS: NY-7.NS.A.1.C

Understand subtraction of rational numbers as adding the additive inverse, p - q = p + (-q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.

Objectives: I can use additive inverses and my knowledge of adding integers to subtract integers.

Lesson Materials: Guided notes, computers for every student or pairs of students, whiteboards for students (optional)

Lesson 3 Outline:

Warm Up (5-10 minutes):

- Students come in and start warm up, on their own, for about 2-3 minutes

- Have students share their answers in partners or groups for about 2 minutes

- While students are discussing, walk around and check in on groups, making sure students have correct answers

- Ask students guiding and scaffolding questions to work through the problem together

Guided Notes (10-12 minutes):

- Ask students to take out their notebooks to take notes or print out guided note sheet to give to students

- Draw number lines for each problem

- Ask students guiding questions to help fill in the notes and solve the problems

Activity:

- Have students work in groups/partners

- With Quizizz you can do a live game and have students physically move into groups or pairs and share a computer or choose the "team" setting where they are placed onto teams and get their points accumulate for their team
- Let students use whiteboards to show their work and better work as a group
- While students are working, rotate around and check in with them
- When students are finished look at the breakdown of questions and go over ones that many students got wrong

Quizizz https://quizizz.com/admin/quiz/5f9f3eb43566e1001bef6f4e

Exit Ticket:

- Have students go on computers and fill out the exit ticket (Google Form)

Assessment: The exit ticket will be used as an informal assessment. It first gives reflection questions, providing students to be self-reflective on their learning. Then the questions at the bottom are specific to the lesson. If students are doing well on them, then a more challenging warm up can be given the next day. If not, spend time the next day going through a similar question and asking students guiding questions to reteach.

Lesson 3 Materials:

Warm up:

1. An elevator is 3 floors below the ground floor. It then goes up 5 floors and then down 7. What floor is the elevator on now relative to the ground floor? Write a number sentence and then evaluate it.

Guided Notes:

Subtracting Integers

1. Alexis buys 10 Gatorades and then gives away 6 of them. How many does he have left?

   Represent this as addition on the number line.

   Now how would we do this problem using subtraction?

   Now represent it on the number line again, using subtraction.

   What do you notice?

   We can rewrite addition problems as subtraction problems and vice versa because addition and subtraction are inverse operations.

   Step 1: Keep the first number the same
   Step 2: Change the operation (addition ↔ subtraction)
   Step 3: Change the last number to the opposite sign (positive ↔ negative)

2. In Chicago, the temperature was -4 degrees at 8 pm and was -12 degrees at midnight. What is the difference between the temperature at 8 pm and the temperature at midnight?

   Represent this as subtraction, rewrite it using addition and find the solution.

Lesson 4: Mathematical Modeling

This lesson is designed to have students practice rewriting subtraction problems and addition problems and solving them. This lesson has no guided notes, just a hands-on activity. The matching activity allows them to be engaged in the learning in a manner that is more entertaining to them than just practicing on paper. Students will be working together and engaging in mathematical discourse to solve the problems. Students can use the whiteboards again to effectively communicate their thoughts while working. Encourage them to use mathematical modeling by drawing number lines if they get stuck. When students are finished, some of the more difficult problems can be reviewed to be sure students are understanding.

Lesson Title: Subtracting Integers Practice

CCSS: NY-7.NS.A.1.C

Understand subtraction of rational numbers as adding the additive inverse, p - q = p + (-q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.

NY-7.NS.A.3

Solve real-world and mathematical problems involving the four operations with rational numbers.

Objectives: I can match addition and subtraction expressions using additive inverse and evaluate those expressions.

Lesson Materials: Activity sheet for each group of students, set of cards for each group of students, glue for each group of students, whiteboards (optional)

Lesson 4 Outline:

Warm Up (5-10 minutes):

- Students come in and start warm up, on their own, for about 2-3 minutes

- Have students share their answers in partners or groups for about 2 minutes

- While students are discussing, walk around and check in on groups, making sure students have correct answers

- Ask students guiding and scaffolding questions to work through the problem together

Activity: (20-30 minutes)

- Have students get into groups of 3-4

- Ask one student from each group gather materials (1 set of cards, one activity sheet and one glue stick, whiteboards)

- Read instructions on activity sheet to students

- Let students work together, matching cards together and gluing them onto the activity sheet

- Encourage students to do their work on the whiteboards

- While students are working, walk around and check in on students

- When they are finished go over one's they had trouble with

- Have student hand in their activity sheet

Assessment: The activity sheet will be graded based on accuracy. Students will receive points for every correct set they get and partial credit. When grading the activity focuses on students' ability to switch the subtraction problems into addition problems. Look for common misconceptions. If students are really struggling and getting many incorrect, spend some more time going over how to switch them. This may require an additional day to reteach or just some additional time spent on the warm up the next day. If only a few students are struggling, the next lesson will be more practice with adding and subtracting integers.

Lesson 4 Materials:

Warm Up:

> 1. Serena has $54 in her bank account. She buys a hoodie for $65. What is her balance in her bank account now? Write this as a subtraction equation, then rewrite it as a subtraction equation and evaluate it.

Activity Sheet:

> Instructions: With your groups, put the cards into sets of 3. Every set of 3 will include an addition expression, an equivalent subtraction expression and their solution. You will have a total of 8 sets. The colors are for fun, they do not mean anything.
>
> | Set 1 | Set 2 | Set 3 | Set 4 | Set 5 | Set 6 | Set 7 | Set 8 |
> |-------|-------|-------|-------|-------|-------|-------|-------|
> | | | | | | | | |

Activity Materials:

-14+2	-7+5	-14-(-2)	5-7	-12	-2
7+(-5)	4+(-9)	7-5	-9-(-4)	2	-5
-3+4	-4+3	-3-(-4)	3-4	1	-1
2+14	9+(-6)	2-(-14)	-6-(-9)	16	3

*cut each of these cards out for every partner of students. Note: you can make them bigger by clicking the picture and dragging it to resize.

Lesson 5: Integration of Inquiry Based Learning

This lesson involves a hands-on activity that uses financial situations to add and subtract positive and negative integers. In each situation students will use Inquiry-based learning to help them determine if they need to add or subtract in each situation. This will help them develop a deep understanding of the meaning of these key words and how they translate into mathematical expressions. This lesson allows students to connect to the material through authentic questions and situations. The name and situation in the activity can be modified at the teacher's discretion. Middle school students are often very curious about their teachers' lives outside of the classroom. Teachers incorporating small details about their personal lives allows students to developer a deeper connection with their teacher. Depending on students' understanding, the quiz can either be given at the end of this lesson or during a following lesson.

Lesson Title: Adding and subtracting integers

Culturally Responsive Pedagogy in an Integers Unit

CCSS: NY-7.NS.A.1.D

Apply properties of operations as strategies to add and subtract rational numbers.

Objectives: I can use context clues and key words in word problems to help determine if I need to add or subtract and create number sentences.

I can evaluate the integer addition and subtraction problems that I create.

Lesson Materials: 1 activity sheet for each group, set of cards for each group, glue, short quiz

Lesson 5 Outline:

Warm Up (5-10 minutes):

- Students come in and start warm up, on their own, for about 2-3 minutes

- Have students share their answers in partners or groups for about 2 minutes

- While students are discussing, walk around and check in on groups, making sure students have correct answers

- Ask students guiding and scaffolding questions to work through the problem together

Activity (15-25 minutes):

- Have students get in groups of 3-4

- Ask 1 group member to gather materials (1 activity sheet, 1 set of cards, glue stick)

- Read directions with students

- If students need more support, do an example with them, if not let them get started

- Students should work together to arrange cards and create number sentences. If needed they will change subtraction problems into addition problems and then evaluate them

- They will glue the cards onto the activity sheet

- When students are finished, they can hand in their activity quiz and start their quiz

Short quiz (5-10 minutes)

- Students should go back to their seats and start the quiz

- They should hand in the quiz at the end of the period

Assessment: The quiz is going to be graded for accuracy. Students will demonstrate their knowledge of adding and subtracting positive and negative integers. The first question has them demonstrate their knowledge of changing subtraction problems to addition problems. The second question allows them to demonstrate their knowledge of number lines. If students do well on the quiz, they are ready to move on to the next topic. If students are still struggling then the optional 6th lesson can be done to review some more. The quiz can also be moved until after lesson 6 if more practice is needed and the financial activity can be graded.

Lesson 5 Materials:

Warm Up:

1. Give an example of a positive and negative temperature where the difference is -5°F.

Activity Sheet:

Directions: Ms. Holcomb is trying to figure out if she has enough money to buy a $100 pair of Nikes. Her other monthly finances are represented in the cards. Place and glue the cards on the card column below and create a number sentence for each. Then, find the new total. When finished answer the questions below.

Card	Number Sentence	New Total

Reflection Questions:
1. Does Ms. Holcomb have enough money to buy her new Nikes?

2. Which words told you to add?

3. Which words told you to subtract?

4. Choose one of the number sentences from above where you subtracted. Rewrite it using addition.

Activity Materials:

Ms. Holcomb spent $28 on a water bottle	Ms. Holcomb bought $62 worth of groceries	Ms. Holcomb spent $25 renting Halloween movies from Amazon Prime	Ms. Holcomb bought some pumpkins for $25	Ms. Holcomb made $55 babysitting
Ms. Holcomb got $10 from her mom as an allowance	Ms. Holcomb spent $34 on Halloween costumes for her cats	Ms. Holcomb paid her $75 electricity bill	Ms. Holcomb earned $200 for working	Ms. Holcomb earned $15 walking cats

*cut each of these cards out for every partner of students. Note: you can make them bigger by clicking the picture and dragging it to resize.

Quiz:

Name:

Subtracting Integers Quiz

Directions: Show all work!

1. The temperature in Chicago at 5 pm was -5 degrees. The temperature **change** was recorded for a few hours on the table below:

Hour	Change in temp	Temperature
1 (6 pm)	+7	
2	-5	
3	-4	
4	+1	

   a. Fill in the temperature in the last column for each hour

   b. Rewrite the subtraction problems as addition problems (HINT: there are 2).

   c. What was the difference from the warmest temperature to the coldest temperature?

2. Draw a diagram **AND** write the elevations for the situations described below.

   A. There is a bat 12 feet above the earth's surface at the top of the cave.

   B. A woman is cave diving 23 feet below the bat.

   C. There is a spider 2 feet below the woman.

   D. There is a mouse 7 feet below the woman, on the bottom of the cave.

   E. From top to bottom, how big is the cave?

Lesson 6: Hands-on Activities as Review

This activity is very hands on and requires a bit more planning and moving around. It is designed to be used as a review before a quiz or test. If desired, the quiz from lesson 5 can be changed to the day after this lesson.

Set Up: To set up the classroom for volleyball desks need to first be moved so that there is a space in the middle with about 5 desks in each row facing one way and then 5 desks in each row facing the other way. The 2 different sets of rows should face each other (usually, 3 rows of 5 facing the right side of the room and 3 rows of 5 facing the left side of the room). Put up a streamer between the two teams to serve as a net. It should go from one end of the room to the other and taped to the front and back walls. The streamer needs to be low enough for students to easily get the ball over it without leaving their desk but slightly higher than their heads (about 6 inches). The "out of bounds" is the part of your classroom with no desks in it and the areas where students would not be able to reach the ball without getting out of their seats. Have a whiteboard and marker for each group. Make sure students can see the smartboard/projector from their seats.

The Game: Instruct students that they need to stay in their seats the whole game. Pick one team to start (team 1). Show the question and give them time to think and answer. Encourage both teams to be working on the problem, because if team 1 gives an incorrect answer team 2 can steal. Give some time and instruct students to share their answer with the teams appointed spokesperson and write it down (team 1). Then have them hold up their whiteboard. Have team 1's spokesperson explain how they got their answer. If their answer is correct, the team gets a point and will serve the volleyball. They can just lightly throw it up in the air and hit it over the

net. Then have students hit the ball back and forth. If it goes under the net, the point goes to the

team that didn't hit it under the net. If it goes out of bounds, the point goes to the team that did

not hit it out of bounds. Once they are done playing volleyball get the ball back and display the

next question. Have team 2 start by answering the question. If a team gets the question wrong

then the other team has the opportunity to answer it. If they get it right, they get the point and the

volleyball. If they get it wrong then both teams get two more opportunities to answer correctly. If

the class still cannot come up with the correct answer then no point will be awarded and the

game should pause so that the question can be reviewed with the class. For added enjoyment for

the students, random trivia questions can be added to the end.

Lesson Title: More Practice Adding and Subtracting Integers

CCSS:NY-7.NS.A.1.D

Apply properties of operations as strategies to add and subtract rational numbers.

NY-7.NS.A.1.C

Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show

that the distance between two rational numbers on the number line is the absolute value of their

difference, and apply this principle in real-world contexts.

NY-7.NS.1: Apply and extend previous understandings of addition and subtraction to add and

subtract rational numbers. Represent addition and subtraction on a horizontal or vertical number

line.

Objectives: I can demonstrate my knowledge of adding and subtracting positive and negative integers.

Lesson Materials: Ability to move desks, beachball, streamer (long enough to split classroom in half), tape, 2 whiteboards, 2 expo markers

Lesson 6 Outline:

Activity:

- Have students sit in 2 groups on different sides of the room (pre-decided groups can be made)
- Make students stay in their seats and go over the rules in the PowerPoint with the students
- Play volleyball

Lesson 6 Materials:

https://docs.google.com/presentation/d/1vvLjkC2RnJTP4XatmqC9nbhn5wnXrrtvzmMNyoKjhfc/edit?usp=sharing

My Personal Suggestion for the Classroom

Building relationships with students has always been a key component to a successful classroom. Every student brings different life experiences and perspectives into the classroom, so it is no surprise that students have different learning styles and different interests. The primary focus of every teacher should be to develop an understanding of who their students are as learners and people.

In my classroom, I have found that students learn best when they feel respected, represented and cared for. My lessons focus a lot on using authentic questions and problems that students can relate to their lives. When students are able to relate a problem to their life, they are more likely to be engaged. For example, I use problems that talk about sneakers or sports, both of which are interests of my students. I also use a lot of hands-on activities such as matching activities and games. Another one of my students' interests are games. They love anything that is a competition or anything that will get them a prize. This is why I have included so many games in my lessons. Mathematics sometimes gets the reputation of being boring. However, after playing Mathematics Volleyball I had students telling their friends that that was the most fun they ever had in school. Playing games like Mathematics Volleyball or Adding War, allow students to see mathematics as something that can be fun and not scary or hard. While playing games in class can be great, it also has its drawbacks. Some students take advantage of the less structured environment that these games create. It is very important to always be circling and making sure all students are working to the best of their abilities.

In addition to knowing my students interests I also know how they learn best. As middle schoolers, they tend to have a shorter attention span. Due to this, I only do guided notes for about 10 minutes. I know anything longer than that will cause them to lose interest. The use of Inquiry Based Learning can be an easy remedy for this. This allows them to take ownership of their own learning and come to conclusions on their own instead of being given notes and taught directly. Students also benefit from having multiple means of representation. While many means of representation are given throughout these lessons, one of the most important is modeling. Modeling gives them a way to turn something abstract into something concrete and visual that they can manipulate. Throughout my lessons, students are often working together, which allows

very important mathematical discourse to take place. Students engage in conversations where they are explaining math using their own language and their own understanding of the concept.

Conclusion

In this ever-changing world, it has become increasingly important to accept and learn about other cultures. It is important to foster an environment where students feel represented and cared for. This environment, in conjunction with culturally repsonsive pedagogy, makes students more likely to engage with the content presented.

A key component in using a culturally responsive pedagogy is learning about the individual students and how they come together as a class. Many middle school students can benefit from a classroom environment where they have multiple means of demonstrating their learning. This can be done through Inquiry Based Learning, authentic questions, modeling and hands on activities. It is the authors hope that this information can give teachers some ideas on how to create a more welcoming and engaging environment for their students.

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Appendix

Lesson 1 answer keys:

Warm Up:

> 1. Give an example of when positive integers are used in real life.
>   Speed, time, money (earn), elevation, temperature
>
> 2. Give an example of when positive integers are used in real life.
>   Spending money, temperature (cold), elevations (below sea level)

Guided Notes

Adding Integers

> 1. The temperature outside is -8 degrees at 6 a.m. and increases 14 degrees by noon. What is the temperature at noon?
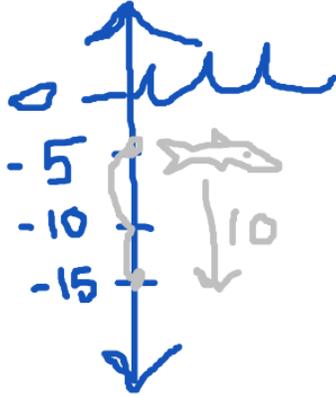>   -8+14=6
>
>
>
>   6 degrees
>
>   When we add a positive number, we move ___up__ or ___right___ on the number line

2. A dolphin is swimming 5 feet below the surface of the water and swims down 10 feet. What is the final elevation of the dolphin, relative to the surface of the water?

-5+(-10)=-15

-15 feet below the surface of the water

When we add a negative number, we move __down_ or __left___ on the number line

3. Brianna owes her mom $3 and then borrows $6 more dollars. How much does she owe her mom now?
-3+(-6)=-9

She owes her mom $9

Lesson 2 answer keys:

Warm Up:

Show all work for this warm up:

1. A climber is climbing above a cave. He starts 7 feet above the cave and then descends 12 feet. What is his new elevation relative to the entrance of the cave (0)?
   7+(-12)=-5
   -5

Guided Notes:

Adding without a number line

When you add numbers with different signs...
   1. Determine which number has the greater absolute value (Ignore the signs, figure out which number is bigger)
   2. Take the sign of the number with the larger absolute value
   3. Subtract the absolute values

1. The Bears are at the 15-yard line and they get pushed back 7 yards. What yard line are they at now?
   15+(-7)
      1. $|15| > |-7|$
      2. 15 is positive
      3. 15-7=8

      15+(-7)=8   They are at the 8 yard line

When you add numbers with the same sign…
1. Add the numbers together
2. Take the sign of the numbers

2. Nathan is playing a game. He lost 9 points and then lost another 5. What is his score now?

-9+(-5)
   1. 9+5=14
   2. They are negative

   -9+(-5)=-14
   His score is -14

Short Quiz:

Name:

Adding Integers Quiz

Directions: Please show all work!

1. Draw a **diagram** to represent the situation and **write** the elevation for each:
   a. A man is diving 31 feet below the surface of the water.
      -31
   b. There is a fish swimming 12 feet above him.
      -31+12=-19
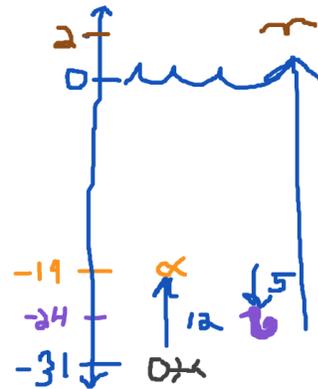   c. There is a seahorse 5 feet below the fish.
      -19+(-5)=-24
   d. A duck is flying 26 feet above the seahorse.
      -24+26=2

2. Fernando started out February owing the bank $23, now his bank account looks like this:

Withdrawal	$20
Deposit	$17
Withdrawal	$13
Withdrawal	$8

a. Use a number sentence to represent Fernando's bank account action using **addition**.
-23+(-20)+17+(-13)+(-8)

b. How much does Fernando have in his account now?
-$47, he owes $43

Lesson 3 answer keys:

Warm up:

1. An elevator is 3 floors below the ground floor. It then goes up 5 floors and then down 7. What floor is the elevator on now relative to the ground floor? Write a number sentence and then evaluate it.
-3+5+(-7)=-5
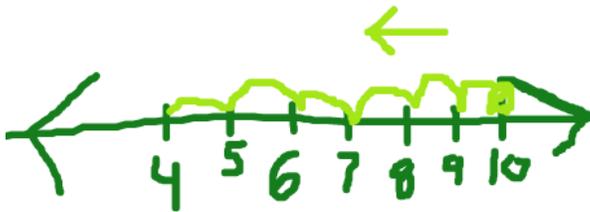It is 5 floors below the ground floor

Guided Notes:

Subtracting Integers

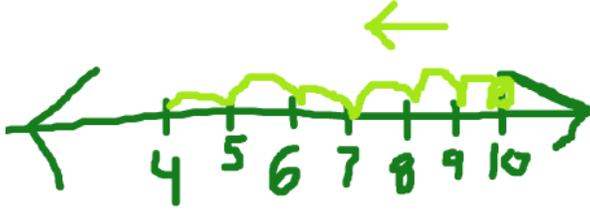1. Alexis buys 10 Gatorades and then gives away 6 of them. How many does he have left?

Represent this as addition on the number line.

Now how would we do this problem using subtraction?

10-6=4

Now represent it on the number line again, using subtraction.

What do you notice?
They both have the same answer and we are moving in the same direction on the number line. So 10+(-6) is the same as 10-6

We can rewrite addition problems as subtraction problems and vice versa because addition and subtraction are inverse operations.

Step 1: Keep the first number the same
Step 2: Change the operation (addition $\leftrightarrow$ subtraction)
Step 3: Change the last number to the opposite sign (positive $\leftrightarrow$ negative)

2. In Chicago, the temperature was -4 degrees at 8 pm and was -12 degrees at midnight. What is the difference between the temperature at 8 pm and the temperature at midnight?

Represent this as subtraction, rewrite it using addition and find the solution.

-4-(-12)
-4+12= 8
The difference between the temperature at 8pm and midnight is 8 degrees

Lesson 4 answer keys:

Warm Up:

1. Serena has $54 in her bank account. She buys a hoodie for $65. What is her balance in her bank account now? Write this as a subtraction equation, then rewrite it as a subtraction equation and evaluate it.
   54-65
   54+(-65)
   -11
   She owes the bank $11

Activity Sheet:

Instructions: With your groups, put the cards into sets of 3. Every set of 3 will include an addition expression, an equivalent subtraction expression and their solution. You will have a total of 8 sets. The colors are for fun, they do not mean anything.

Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8
-14+2		7+(-5)		9+(-6)		-4+3	
-14-(-2)		7-5		-6-(-9)		3-4	
-12		2		3		-1	
	-3+4		4+(-9)		-7+5		2+14
	-3-(-4)		-9-(-4)		5-7		2-(-14)
	1		-5		-2		16

Lesson 5 answer keys:

Warm Up:

1. Give an example of a positive and negative temperature where the difference is -5°F.
   3-(-2)=5

Activity Sheet:

Directions: Ms. Holcomb is trying to figure out if she has enough money to buy a $100 pair of Nikes. Her other monthly finances are represented in the cards. Place and glue the cards on the card column below and create a number sentence for each. Then, find the new total. When finished answer the questions below.

Card	Number Sentence	New Total
Ms. Holcomb spent $28 on a new water bottle	0-28 0+(-28)	-$28
Ms. Holcomb got $10 from her mom as an allowance.	-28+10	-$18
Ms. Holcomb bought $62 worth of groceries	-18-62 -18+(-62)	-$80
Ms. Holcomb made $55 babysitting	-80+55	-$25
Ms. Holcomb spent $34 on Halloween costumes for her cats	-25-34 -25+(-34)	-$59
Ms. Holcomb earned $200 for working	-59+200	$141
Ms. Holcomb paid her $75 electricity bill	141-75 141+(-75)	$66
Ms. Holcomb spent $25 renting Halloween movies from Amazon Prime	66-25 66+(-25)	$41
Ms. Holcomb bought some Pumpkins for $25	41-25 41+(-25)	$16
Ms. Holcomb earned $15 walking cats	16+15	$31

Reflection Questions:
1. Does Ms. Holcomb have enough money to buy her new Nikes?
   No, she only has $31 and needs $100

2. Which words told you to add?
   Got, made, earned

3. Which words told you to subtract?
   Spent, bought, paid

4. Choose one of the number sentences from above where you subtracted. Rewrite it using addition.
   Any of the number sentences with subtracting from above

Quiz:

Name:

Subtracting Integers Quiz

Directions: Show all work!

1. The temperature in Chicago at 5 pm was -5 degrees. The temperature **change** was recorded for a few hours on the table below:

Hour	Change in temp	Temperature
1 (6 pm)	+7	-5+7=-2
2	-5	-2-5=-7
3	-4	-7-4=-11
4	+1	-11+1=-10

   a. Fill in the temperature in the last column for each hour

   b. Rewrite the subtraction problems as addition problems (HINT: there are 2).
      -2-5= -2+(-5)
      -7-4=-7+(-4)

   c. What was the difference from the warmest temperature to the coldest temperature?
      -2-(-11)= 9

2. <u>Draw a diagram</u> **AND** <u>write the elevations</u> for the situations described below.

   A. There is a bat 12 feet above the earth's surface at the top of the cave.
      +12
   B. A woman is cave diving 23 feet below the bat.
      12-23= 12+(-23)= -11
   C. There is a spider 2 feet below the woman.
      -11-2=-11+(-2)=-13
   D. There is a mouse 7 feet below the woman, on the bottom of the cave.
      -11-7= -11+(-7)= -18
   E. From top to bottom, how big is the cave?

12-(-18)= 12+18= 30
The cave is 30 feet high

Lesson 6 answers in PowerPoint notes