

IMPROVING STUDENT LEARNING AND NUMBER SENSE THROUGH THE
COMBINATION OF COOPERATIVE LEARNING AND NUMBER TALKS

By

Timothy Paul Augustin

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Capstone Project Facilitators: Jennifer Carlson & Kelly Killorn

Content Expert: Erica Daher

Peer Reviewer: Scott Pierce

CAPSTONE PROJECT

Research Question

How do math interventions with a focus on number sense, primarily number flexibility and conceptual understanding of numbers, coupled with cooperative learning improve mathematical literacy for elementary students?

Project Type

This project is a curriculum based project that is designed to improve student confidence and student number sense. Through the use of two pedagogical techniques, cooperative learning and Number Talks, students should be able to improve in these two areas. The project is to be implemented in three phases, each phase lasts approximately one month. Phase one or month one is the introductory phase, this is where the students are introduced to each other and are learning how to build a foundation for learning. The students will participate in team building activities and will also take assessments to determine their mathematical ability. In phase two or month two the students participate in more team building activities to strengthen the team, but now they begin to practice cooperative learning with their groups and Number Talks. Month two focuses on learning how to build a strong classroom community while learning how to strengthen their number sense. For the final phase or month three, students participate in more team building activities, but the focus for this month is to rely on their team members more and work cooperatively as they participate in the daily Number Talks. Throughout the three month study students and the teacher are asked to participate in a series of assessments that are aimed to assess the success of the project.

Project Description

The project is to be implemented in three phases, each phase will last approximately one month. A teacher assessment, designed for the teacher to reflect on the classroom environment, is used each month to gauge progress of the project. The project starts with team building activities to help strengthen and build the community. After the team building activities, the students will be introduced to cooperative learning. I plan on starting slow with the students by having the first cooperative learning groups consist of two students. The reason for this is to get the students comfortable sharing their ideas with each other and establishing a working community. Next, will be the introduction to Number Talks, which are 10-15 minute math activities that are meant to encourage the students to think about math and solving problems in multiple ways. Before moving on to the next stage of the project, the students will be taking a computerized test that will measure mathematical growth and automaticity of basic math facts. The final piece before the next phase is a pre-assessment. For the pre-assessment students are given the mathematical problem, $74 \div 2$, and they will try to solve it in as many different ways as they can. The range of solutions varies between one and five. The pre-assessment measures how well the students are able to use their number flexibility and conceptual understanding skills.

In month two, there is another team building activity that is designed to reinforce and strengthen the cooperative learning groups. The teacher completes another self assessment on the classroom environment and the progress of the project. Next, the cooperative learning groups will expand from two students to four students. The reason for the expansion is to build a more cohesive learning environment and increase collaboration. Along with the expansion, Number Talks will continue to be taught in a similar manner. The exception will be that the discussion will be done within the cooperative learning groups with a share out as I scribe their

strategies on the board. The cooperative learning groups will also have an opportunity to complete a weekly reflection on how the group is working together. I will be reviewing these reflections and making adjustments to the groups if necessary.

The final month begins by facilitating another team building activity that will consist of students providing feedback to their peers about how well they worked together as a group. Finally, this month consists of a student driven Number Talks. The Number Talks are posted on the board to start the day and the students will get into their cooperative learning groups and complete the Number Talks as a group. Each student completes their assigned role for the week and again will complete a weekly reflection about their group. The final component to wrap up the third month is a post-assessment, which is another look at the $74 \div 2$ assessment. Again, like the pre-assessment, students will be asked to solve $74 \div 2$ in as many different ways they can. The goal is for each student to be able to solve the problem in three or more different ways. This final assessment provides data to see if the students are progressing with number sense. The teacher completes a final self assessment to determine the effectiveness of the classroom environment and the success of the project.

Audience

The audience intended for the project are elementary school teachers that are looking for ways to improve student confidence and improving student mathematical understanding using two proven pedagogical techniques.

Project at a Glance

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	Activities	Description	Materials	Resources
Month #1	Assessment for Teachers	The assessment is intended to assist teachers in being	Printed Assessment	Assessment for Teachers

		reflective with their current level of supporting students.		
	Whiteboard Challenge	The whiteboard challenge is designed to build and strengthen the community. The students will use the geometric figures sheet for shapes to draw. The directions are located in the resources section.	Whiteboard, Dry Erase Markers, Paper	Whiteboard Challenge
	Whiteboard Challenge	Geometric figures cards are used for the Whiteboard Challenge.	Printed Shape Cards	Geometric Figures
	Two Truths and a Lie	The Two Truths and a Lie game is designed to build and strengthen the community. The directions are located in the resources section.	Paper	Two Truths and a Lie
	Cooperative Learning Questionnaire	The students will complete a short cooperative learning questionnaire that will help divide into student groups.	Printed Questionnaire	Cooperative Learning Questionnaire
	Cooperative Learning Groups of Two	Students will be placed into groups of two and will participate in Number Talks.	Role Cards, Whiteboard, Dry Erase Marker.	Role Cards for group of Two
	Number Talks	Number Talks will be modeled by the teacher during large group instruction. Hand signals will be used.		Number Talk Hand Signals
			Google Slide	Number Talks Examples
	FAST Assessment	Computer based assessment taken by each student to measure growth, as required by ISD 831.	Computer	

	Automaticity Assessment	Computer based assessment taken by each student as part of ISD 831 requirements. This assessment measures basic math fluency for addition, subtraction, multiplication, and division.	Computer	
	$74 \div 2$ Pre-assessment	An assessment that is used to help determine a student's number sense. This is a pre-test; it will be given again at the end of month three to measure progress.	Printed Assessment	74÷2 Assessment
Month #2	Assessment for Teachers	The assessment is intended to assist teachers in being reflective with their current level of supporting students.	Printed Assessment	Assessment for Teachers
	Life Savers Go-Cart	The Life Savers Go-Cart activity is designed for students to begin working collaboratively in small groups.	Life Savers Candy, Straws, Toothpicks, Scissors, Paper, Masking Tape, Electric Fan	Life Savers Go-Cart
	Cooperative Learning Groups of four	Cooperative learning groups expand to four. Each person is assigned a role in the group.	Role Cards	Role Cards for group of Four
	Number Talks	Same structure but the Number Talks discussion is done amongst the group.		Number Talk Hand Signals
			Google Slide	Number Talks Examples
	Cooperative	Students will fill in a	Printed	Weekly Group

	Learning Weekly Reflections	weekly reflection that will help determine the success of the group.	Reflection	Rating
Month #3	Sum of All Skittles	Students will share positive experiences with each other based on group work.	A bag of Skittles Candy	Sum of All Skittles
	Student lead Cooperative Learning and Number Talks	Continue to do the cooperative learning groups and Number Talks with students leading.	Role Cards	Role Cards for group of Four
	Cooperative Learning Weekly Reflections	Continue to do the weekly reflections.	Printed Reflection	Weekly Group Rating
	Final 74÷2 Assessment	Take the final 74÷2 assessment to determine if students made progress with number sense.	Printed Assessment	74÷2 Assessment
	Final Assessment for Teachers	The assessment is intended to assist teachers in being reflective with their current level of supporting students.	Printed Assessment	Assessment for Teachers

Project

As you read through each month, you will first see actions and classroom strategies followed by methods of data collection to gauge student progress.

Month #1:

Actions: To begin the month, the teacher takes a self assessment to reflect upon their current level of relational capacity. Next, there are various team building activities to strengthen the community. The activities are done for one week. The students are split into groups of four; it

does not matter who is in which group since they will be rotating each day. The following team building activities will be used:

- Whiteboard Challenge
- Two Truths and a Lie

For the whiteboard challenge, the students pair up and then join another pair of students. The challenge will begin by having one person from each pair do a job. The first job is to be the drawer and the second job is the explainer. The person doing the explaining explains to the person drawing how to draw the object without saying what the object is. For example, if the object is a circle, the explainer could say draw a half moon shape, then connect the half moon with another half moon. The other two group members have the opportunity to guess what the shape is based off of the drawing. The activity is done when each person has had a chance to be the drawer and the explainer.

Two truths and a lie is played by having each person write down two truths and one lie on a piece of paper. The students then go around to each person and try to guess which statement was the lie. After they guess the lie, the next person goes.

Data Collection: The purpose of the teacher self assessment is for teachers to assess themselves and the level of positivity in the classroom environment as students continue to grow as collaborators. The purpose of these team building activities is for the students to get to know each other. The students are building the community and learning about each other. The teacher monitors and observes students and records any necessary observations as they participate in the activities to see who is working well with each other. The students will also take a short cooperative learning questionnaire that will be used to get information from the students to help form groups moving forward.

Actions: Based on the data collected from the activity above, students are placed in groups of two in order to establish and build strong relationships so students' level of comfort is increased for discussions. The instructor begins by modeling what students should do in the small group. This action will last one week. First, each group member will have a role card that will explain their responsibility. The roles are:

- One person is responsible for writing on the whiteboard and discussing the problem
- One person is responsible for explaining and communicating their solution to the problem

The teacher teaches the math lesson for the day and provides the students an opportunity to practice the lesson. The teacher writes the problem on the board for each group to solve. Each group member discusses the problem with each other and comes up with a solution as a group. After two minutes, the teacher asks if any groups would like to share their answers. The teacher writes the students' strategy on the board. The teacher asks if anyone has any questions about how the problem was solved.

Data Collection: The data collected with this activity determines how well they are communicating with each other. The teacher records the observations that were made during the activity. The teacher also evaluates how well they are practicing their roles and intervenes and models if necessary.

Action: The next activity is the introduction of Number Talks. The teacher explains the process and importance of Number Talks and how they are going to be instilled. To begin the teacher models the hand signals that will be used for Number Talks. They are as follows:

- A closed fist (Means that the student is thinking of strategy)
- A thumbs up (Means that the student is ready to share their strategy)
- A thumb up with the pointer finger out (Means that the student has a different strategy)

- A pinky and thumb up with three fingers tucked (Means that the student agrees with the solution that was presented by another student)

The importance of doing hand signals in a large group is so everyone can have an opportunity to practice their hand signals and establish the routine for the expectations during the Number Talks. After the students have had an opportunity to practice their hand signals, it is time to begin a Number Talk. Students start with a closed fist, as a signal to the teacher that they are ready. The teacher uses a Google Slide Number Talks instruction. The teacher starts by projecting the math problem on the board. Once students have developed their strategy, they use their second hand signal, a thumb up. This tells the teacher that the students are ready to share their strategy. Once a majority of students have their thumb up, the teacher calls on a student to share their answer. The teacher writes the answer or answers on the board. The teacher asks the students who shared their answers to explain their strategy. The teacher uses a series of questions that were developed from Boaler (2015, p 180). They are as follows:

- “How did you think about the problem?”
- “What was the first step?”
- “What did you do next?”
- “Why did you do it that way?”
- “Can you think of a different way to do the problem?”
- “How do the two ways relate?”
- “What could you change about the problem to make it easier or simpler?”

This action will last two weeks.

Data Collection: The data collected is how well they are able to use their hand signals. The teacher records which students are consistently ready to share their strategy. The teacher also

records to determine if multiple strategies are being used. The teacher also observes the large group to identify who is taking a risk and sharing with the large group and records the information. The teacher creates a room map with student names on the map where each student sits. On the map the teacher puts a tally mark next to the students name that is used to determine which students are participating.

Action: The final action for month one is the FAST (Formative Assessment System for Teachers) assessment and automaticity assessment. These assessments are district requirements completed each year to determine growth of students in the fall, winter, and spring. The automaticity test is taken along with the FAST test to measure how automatic students are with their basic math facts. After the students take these two tests, they will have a final assessment which is $74 \div 2$. The students attempt to solve problems in as many different ways as they can.

Data Collection: The data collected with the FAST test measures if students are progressing with their mathematical skills. The data is saved and compared two more times during the year. It also highlights which areas students are struggling with so the teacher can target those areas using Number Talks. The data the teacher collects for the automaticity test determines which facts they struggle with and again focuses on those facts using Number Talks. The data that is collected in the last assessment determines where the students are with their thought process of being able to use multiple strategies. Through Number Talks, multiple strategies are used to solve each problem.

Month #2:

Action: To start month two, the teacher takes another self assessment to make sure that the groups and activities are working as the teacher reflects upon how students feel in the class. It is

also an opportunity for the teacher to make adjustments if necessary. Next, there is a team building activity, Life Savers Go-Cart, which is designed to continue to build on the strength of the community. The Life Savers Go-Cart activity lasts for one-week. The students are split into groups of four. The students attempt to work together to create a Life Saver Go-Cart using the materials that are provided.

Data Collection: The data collected with the teacher assessment helps prepare the teacher for month two. The data collected for the Life Savers Go-Cart activity is to assess how well the students are able to work and communicate with each other to accomplish a main goal.

Action: The establishment of cooperative learning groups increases to groups of four. This will last the whole month. The teacher explains all of the guidelines for the group along with the roles of each member. The guidelines are as follows:

- Each student will have a voice
- The group will need to be respectful to each other
- Each member will need to be an active participant
- Each student will be assigned a role each week
- Each student will come to class prepared

Each group will be given a set of role cards so they are familiar with their roles for the week. The roles of each student are as follows:

- Facilitator (The leader of the group; they are responsible for getting the group started.)
- Questioner (Responsible for asking questions to the group that extend their thought process.)
- Scribe (Responsible for writing down the answers and the strategy of each group member.)

- Timekeeper (Responsible for keeping the group on task and on time.)

Data Collection: Each group member will fill out a weekly rating for the group. The teacher collects these ratings and analyzes them for group cohesion. If there are ratings of one or two, the teacher will make adjustments to the group which could include changing group members. Based on feedback from the weekly ratings, adjustments are made to accommodate all learners with a focus on the needs of English Language Learners and Special Education students.

Action: The combination of Number Talks and the cooperative learning groups are established. The Number Talks will be done the same as the large group; except the students will be completing the roles of the teacher in their cooperative learning groups. This part will be done for the whole month. The guidelines for the Number Talks are as follows:

- Each student will need to follow the hand signals that are located on the poster at the front of the room.
- The students will need to be respectful to each other.
- Each student will be an active participant.

Data Collection: Each group member will fill out a weekly rating for the group. The teacher collects these ratings and analyzes them for group cohesion and understanding of the mathematical concepts. If there are ratings of one or two, then the teacher makes adjustments to the group. The teacher walks around and observes and records each group for understanding of the math problem and group cohesion. Also, adjustments are made to each group based on the pace of each group; for example, if a student is excelling at number talks accommodations are made. For example, students who are excelling could be given a more challenging problem to analyze.

Month #3:

Action: To begin this month there is another team building activity, Sum of All Skittles. This activity is designed for students to positively reflect on the progress they have made with their group. It is also designed to build student self esteem. The activity will last for two days. The activity begins by having the students divide into their cooperating learning groups. After they are in their groups, the teacher places Skittles in a bowl in the middle of the group. Each student can take a maximum of five Skittles, but they must take at least one. If they take five Skittles then the students write and share one sentence per Skittle with their group that is positive. Some examples of sentences are (Bendall et al., 2015, p. 65):

- How one classmate has positively impacted the group.
- One positive thing that you have learned about a classmate.
- One great memory that you have had.
- One thing that you have learned about yourself.
- One thing that you appreciate about a classmate.

Data Collection: The data collected for the Sum of All Skittles activity is designed to assess positive learning that has occurred. It is also designed to help the creation of groups in the future. If the student feedback is positive, then the teacher can continue to use the same structure moving forward.

Action: The action this month is student led. The students will start each math class in their small group where they will choose one of the roles for each week. The Number Talks will be on the board for each group. The students will complete the Number Talks in their small groups. The teacher walks around, observes and assists each group as needed. Students will fill out

weekly ratings for their group. Also at the end of the month, each group member will be taking the final assessment of the $74 \div 2$.

Data Collection: At the end of this month, the teacher analyzes the data collected from the student ratings as well as his own observations. The teacher checks to see what was successful and what improvements could be made moving forward. With the $74 \div 2$ assessment, the teacher looks for each student to be able to do at least three different strategies. If they are able to do at least three, then the project was successful. If the students are able to do one or two then the adjustments are needed. The teacher assessment is used to measure the successes of the project in terms of creating a positive classroom environment with strong relational capacity. Based on the assessment the adjustments are made next time.

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