How Infusing Music Into Elementary Mathematics Curriculum Affects Students' Learning and

Engagement

by

Caitlin Riebe

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Capstone Project Facilitator: Jana Lo Bello Miller
Content Expert: Jeff Fink
Content Expert: Anne Norsted
Content Expert: Sandy Yunker

Project Summary

My research question is: *How does infusing music into elementary mathematics curriculum affect student learning and engagement?* My project is a revised version of three units of a second grade mathematics curriculum. It includes lesson plans and teaching slides as well as a teacher script for the first three lessons of each of the three units. This is not a one-size-fits-all approach, so teachers should feel comfortable modifying the provided lessons in a way that is personal to and comfortable for them. While this project was created based on a second grade mathematics curriculum and will be most relevant for second grade teachers, it can be easily adapted to other grade levels and utilized by all elementary teachers.

The curriculum revisions that I created involve integrating music into each unit in the form of newly created songs that align with second grade academic standards, opportunities for musical brain breaks, suggestions for background music that will promote a calm and productive workspace, as well as performance assessment opportunities that allow for students to be creative in the ways that they express their learning and concept mastery.

Music to Promote Learning

The songs that I created and adapted include melodies that are familiar to many students (such as the Happy Birthday song) with new lyrics that reinforce conceptual and procedural understanding of addition and subtraction. Because the songs are tunes that a lot of students may already know, my hope is that they learn the new lyrics quickly and efficiently so they can spend most of their time remembering the words and concepts, rather than having to learn a new melody as well as novel lyrics.

Music During Brain Breaks

As an educator, I know first-hand the importance of brain breaks during lessons for students to get up and move around to "wake up" their brains after sitting for too long. The songs that I have chosen to include as suggestions for brain breaks are songs that are up-tempo, exciting, and will encourage students to move around the room quickly to expend some energy for a couple of minutes and get their bodies and minds moving again. When used correctly, brain breaks are efficient tools to increase attention and engagement and my hope is that by intentionally adding songs that invite students to move quickly, they will get out some of their energy and return to their work spaces ready to tackle the next part of the lesson.

Music During Work Time

Conversely, during work time, it is important to create an environment that promotes calm and productivity. My project also includes ideas of music and songs that are midtempo or slower and those that are orchestral or classical arrangements. These songs do not contain any lyrics, so that students do not become distracted by words being sung while attempting to focus on their work. However, some students may be distracted by music in general during work time. It is important to talk to your students about their preferences before implementing background music in your classroom so that it benefits the maximum number of students possible.

Music for Assessment

The final component of my project offers suggestions for differentiated summative assessments so that students are able to express their learning in more creative ways than paper-and-pencil tests. In my experience as an educator, oftentimes students that are able to correctly answer questions in small or whole group settings struggle to answer the same questions on traditional assessments. For some students, the time limit (or perceived time limit)

creates anxiety; for others, the word "test" creates stress for them; and for others, that method of assessment just isn't right for them. In my revised curriculum, I have outlined different structures to provide to students so they can demonstrate their learning in a different way.

Understanding by Design Framework

Students need a learning plan that is thoughtful, intentional, and thorough. I used the Understanding by Design framework to design the three math units that I revised. When teachers plan their lessons, they should use a backwards design, or plan by starting with identifying what they hope students will be able to know and understand by the end of the unit (McTighe & Wiggins, 2012). After identifying the desired results, they can plan for assessment. Teachers should ensure that the assessments they develop are completely aligned with the learning objectives and goals. In other words, teachers should not assess items that are not directly related to the learning objectives. Once the objectives and assessments are aligned, teachers can begin planning learning activities and the actual instruction that they will implement each day. The goal of a unit created in this way is to ensure alignment from the beginning to end.

Summary

The project that I have created serves as a foundation for incorporating music into elementary mathematical learning experiences. Each unit plan is complete and includes the desired results, assessment evidence, and learning plans. Included within the unit plans are a total of nine complete lesson plans with lesson standards, student objectives, essential questions, slides, ideas for differentiation, and song lyrics. My hope is that by incorporating students' interests, lived experiences, and passions into mathematics curriculum, this project will provide a pathway to academic success for all students.

Unit Title: <u>**Meanings of Addition and Subtraction**</u>

Unit Description: In this unit students will practice and develop fluency in choosing strategies for putting together, taking apart, and comparing numbers; determine whether a word problem requires that they add or subtract in order to find a solution; add up to four 2-digit numbers; explain why addition and subtraction strategies work; represent whole numbers as lengths on a number line; and represent sums and differences on a number line.

Stage 1 - Desired Results

<u>Minnesota Mathematics Academic Standards</u>

- *2.1.1.1 Read, write and represent whole numbers up to 1000. Representations may include numerals, addition, subtraction, multiplication, words, pictures, tally marks, number lines and manipulatives, such as bundles of sticks and base 10 blocks.*
- *2.1.1.2 Use place value to describe whole numbers between 10 and 1000 in terms of hundreds, tens and ones. Know that 100 is 10 tens, and 1000 is 10 hundreds.*
- *2.1.1.5 Compare and order whole numbers up to 1000.*
- *2.1.2.1 Use strategies to generate addition and subtraction facts including making tens, fact families, doubles plus or minus one, counting on, counting back, and the commutative and associative properties. Use the relationship between addition and subtraction to generate basic facts.*
- *2.1.2.2 Demonstrate fluency with basic addition facts and related subtraction facts.*
- *2.1.2.4 Use mental strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers. Strategies may include decomposition, expanded notation, and partial sums and differences.*
- *2.1.2.5 Solve real-world and mathematical addition and subtraction problems involving whole numbers with up to 2 digits.*
- *2.2.2.2 Use number sentences involving addition, subtraction, and unknowns to represent given problem situations. Use number sense and properties of addition and subtraction to find values for the unknowns that make the number sentences true.*

<u>Unit Objectives</u>

<u>Math Objectives</u>
- Students represent and solve Add To problems.
- Students represent and solve Take From problems.
- Students solve two-step Add To and Take From problems.
- Students represent and solve Put Together problems.
- Students represent and solve Take Apart problems.

- Students solve two-step Put Together and Take Apart problems.
- Students represent and solve Compare problems.
- Students solve two-step problems involving comparison.
- Students solve two-step problems using addition and subtraction.

Language Objectives
- Students discuss Add To problems using the verbs *matter* and *belong*.
- Students talk about Take From problems using the verb *know*.
- Students discuss two-step problems including the verbs *connect* and *include*.
- Students talk about representing and solving Put Together problems using *useful* and *help*.
- Students talk about representing and solving Take Apart problems with the verb *using*.
- Students discuss two-step problems using the verb *find*.
- Students discuss how to represent and solve Compare problems using the terms *useful, use,* and *know*.
- Students discuss how to solve Compare problems using verbs *use, find,* and *know*.
- Students talk about solving two-step problems using words such as *first* and *next*.
- Students discuss solving two-step problems using the words *know, find, represent,* and *helpful*.

Adapted from: McGraw Hill- Reveal.

Meaning

Understanding (U): *What kinds of long-term independent accomplishments are expected?*
- Quantities can be combined, taken apart and compared.
- There are many ways that one can add or subtract numbers.
- There is a relationship between addition and subtraction.
- Addition and subtraction properties can be used to solve problems.

Essential Questions (Q): *What thought-provoking questions will foster inquiry, meaning making meaning and transfer?*
- Where do I see addition and subtraction in the real world?
- How do I recognize what strategy to use for a specific problem?
- What strategies can I use to compute sums and differences mentally?
- How can the relationship between addition and subtraction help with problem solving?

Students will know…(Knowledge) *(Noun phrases-facts and basic concepts to recall)*
- Addition is the putting together of parts or adding to a given quantity to reach a given quantity
- Subtraction is the inverse of addition
- Every addition fact has a related subtraction fact, and vice versa (fact families)
- What the symbols +, -, and = represent
- How to represent addition and subtraction problems in many ways

Students will be able to … (Skills) (I can statements)
(Verb phrases-discrete skills and processes to use)
- Recall addition facts
- Identify related addition expressions to solve subtraction facts, as well as identify related subtraction expressions to solve addition facts
- Recall subtraction facts
- Identify addition expressions to solve given word problems
- Identify addition word problems represented by given solution strategies
- Recall addition and subtraction facts to solve word problems
- Identify equations that represent subtraction word problems

Stage 2 - Assessment Evidence

Performance Tasks (T): *How will meaning making and transfer be demonstrated? (Summative Assessment)*

Pre-assessment/Readiness Diagnostic

Assessment Options:
Post-assessment

Create a song, poem, or rap to demonstrate your knowledge of one or more of the following concepts:
- Where do you see addition and subtraction in the real world?
- Create a story problem and explain how to solve it- do you add or subtract? How do you know?
- How are addition and subtraction related to each other?
- What are different ways to compose and decompose a number?
- How can you solve a two-step word problem?

Other Evidence (OE): *What tasks/activities determine whether desired results have been accomplished? Formative Assessments DOK1-2*
1. Exit Slips
2. Independent Practice
3. Observation
4. Conversations (peer-to-peer and student to teacher)
5. Teacher-Created Check-ins
6. Self-reflection

Stage 3 - Learning Plan

Learning Activities (L): *What is the goal for each activity, task, event?*

Anticipated time span for teaching this unit: 16 Days
Core Unit Vocabulary Math Terms • Addend • Number Bond • ==Part-Part-Whole Mat== • ==Unknown== • Equation • ==Bar Diagram== • Sum • Compare ==*New terms for second graders== Academic Terms • Decide • Describe • Solution • Useful • Connect • Quantities • Relate • Represent • Calculation • Check • Necessary • Represent • Organize • Tools • Apply • Solve • Make Sense • Plan

Unit Title: <u>Strategies to Fluently Add Within 100</u>

Unit Description: In this unit students will practice and develop fluency in choosing strategies for putting together numbers; use concrete, pictorial, and abstract representations of addition problems; determine whether a word problem requires that they add or subtract in order to find a solution; add up to four 2-digit numbers; decompose addends to make the addition process easier (make a friendly number); explain why and how addition strategies work; represent whole numbers as lengths on a number line; and represent sums on a number line.

Stage 1 - Desired Results

<u>Minnesota Mathematics Academic Standards</u>

- *2.1.1.1 Read, write and represent whole numbers up to 1000. Representations may include numerals, addition, subtraction, multiplication, words, pictures, tally marks, number lines and manipulatives, such as bundles of sticks and base 10 blocks.*
- *2.1.1.2 Use place value to describe whole numbers between 10 and 1000 in terms of hundreds, tens and ones. Know that 100 is 10 tens, and 1000 is 10 hundreds.*
- *2.1.1.5 Compare and order whole numbers up to 1000.*
- *2.1.2.1 Use strategies to generate addition and subtraction facts including making tens, fact families, doubles plus or minus one, counting on, counting back, and the commutative and associative properties. Use the relationship between addition and subtraction to generate basic facts.*
- *2.1.2.2 Demonstrate fluency with basic addition facts and related subtraction facts.*
- *2.1.2.4 Use mental strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers. Strategies may include decomposition, expanded notation, and partial sums and differences.*
- *2.1.2.5 Solve real-world and mathematical addition and subtraction problems involving whole numbers with up to 2 digits.*
- *2.2.2.2 Use number sentences involving addition, subtraction, and unknowns to represent given problem situations. Use number sense and properties of addition and subtraction to find values for the unknowns that make the number sentences true.*

<u>Unit Objectives</u>

<u>Math Objectives</u>
- Students add fluently within 20. (2 days)
- Students represent addition of 2-digit numbers to find the sum.
- Students understand that addends added in any order have the same sum.
- Students decompose two addends to add.
- Students use a number line to add.

- Students decompose one addend to add.
- Students adjust addends to add.
- Students add up to four 2-digit numbers.
- Students solve one- and two-step addition word problems.

Language Objectives
- Students discuss how to add fluently within 20 while answering *Wh-* questions.
- Students discuss what they understand about doubles and near doubles facts using the verb *notice*.
- Students explain how to add 2-digit numbers to find the sum of an equation while answering *Wh-* and Yes/No questions and using the term *regroup*.
- Students explain why addends can be added in any order using the term *the same*.
- Students explain how to decompose two addends using *can, could,* and *would*.
- Students explain how to use a number line to add while answering *Wh-* questions and using modals such as *should* and *would*.
- Students explain different ways to decompose one addend to add, using the term *another way*.
- Students explain how to adjust addends to add within 100 while answering *Wh-* questions.
- Students explain how to add up to four 2-digit addends while answering *Wh-* questions and using the term *first* when applicable.
- Students discuss solving one- and two-step addition word problems while answering *Wh-* and Yes/No questions.

Adapted from McGraw Hill- Reveal.

Meaning

Understanding (U): *What kinds of long-term independent accomplishments are expected?*
- Counting on, making a 10, doubles, and near doubles can help me add to 20.
- Place value can help me add 2-digit numbers.
- Changing the order of addends can help me efficiently compose numbers.
- I can decompose and adjust addends to help me find a sum.

Essential Questions (Q): *What thought-provoking questions will foster inquiry, meaning making meaning and transfer?*
- Where do I see addition in the real world?
- How do I recognize what strategy to use for a specific problem?
- What strategies can I use to compute sums mentally?
- How can I decompose numbers in order to more efficiently add numbers together?
- How does knowledge of place value help with addition?
- How can the relationship between addition and subtraction help with problem solving?

Students will know…(Knowledge) *(Noun phrases-facts and basic concepts to recall)*
- Addition is the putting together of parts or adding to a given quantity to reach a given quantity

- Numbers can be decomposed in many ways.
- The commutative property: regardless of the order you add addends together, the sum will be the same.
- There are many different strategies that can be used to solve any given addition problem.
- Every addition fact has a related subtraction fact, and vice versa (fact families)
- The equal sign (=) is a symbol that means the total amount on one side of the sign is the same as the total amount on the other side.
- Addition problems can be represented in many ways (concrete, pictorial, and abstract representations).
- Addends can be adjusted to create friendly numbers.
- When to regroup and how to exchange ten ones for a ten

Students will be able to … (Skills) (I can statements)
(Verb phrases-discrete skills and processes to use)
- Recall addition facts
- Identify a missing addend
- Represent addition problems in multiple ways (concrete, pictorial, abstract)
- Use strategies (doubles, count on, make a 10, decompose) to add
- Identify related addition expressions to solve subtraction facts, as well as identify related subtraction expressions to solve addition facts
- Identify addition expressions to solve given word problems
- Recall addition facts to solve word problems
- Use partial sums to add efficiently
- Adjust addends to add efficiently
- Solve two-digit addition problems with and without regrouping
- Check my answers by using subtraction

Stage 2 - Assessment Evidence

Performance Tasks (T): *How will meaning making and transfer be demonstrated? (Summative Assessment)*

Pre-assessment/Readiness Diagnostic

Assessment Options:
Post-assessment

Create a song, poem, or rap to demonstrate your knowledge of one or more of the following addition strategies:
- Counting on
- Making a 10

- Decomposing numbers
- Adjusting numbers
- Doubles
- Fact Families
- Adding 2-digit numbers
- Adding 2-digit numbers with regrouping

Other Evidence (OE): *What tasks/activities determine whether desired results have been accomplished? Formative Assessments DOK1-2*
1. Exit Slips
2. Independent Practice
3. Observation
4. Conversations (peer-to-peer and student to teacher)
5. Teacher-Created Check-ins
6. Self-reflection

Stage 3 - Learning Plan

Learning Activities (L): *What is the goal for each activity, task, event?*

[Daily Lesson Plan Examples](#)

Anticipated time span for teaching this unit: 16 Days

Core Unit Vocabulary

Math Terms
- Addend
- Count on
- Doubles
- Near Doubles
- Regroup
- Decompose
- Friendly numbers
- Partial sums
- Place value
- Number line
- Adjust

*New terms for second graders

Academic Terms
- Represent

- Strategies
- Explanation
- Wonder
- Explore
- Relationship
- Represent
- Strategy
- Compare
- Related
- Arrange
- Compare
- Decide
- Check
- Relate to
- Plan
- Check information related to

Unit Title: <u>**Strategies to Fluently Subtract Within 100**</u>

Unit Description: In this unit students will practice and develop fluency in choosing strategies for taking apart numbers; use concrete, pictorial, and abstract representations of subtraction problems; determine whether a word problem requires that they add or subtract in order to find a solution; decompose numbers to make the subtraction process easier (make a friendly number); explain why and how subtraction strategies work; represent whole numbers as lengths on a number line; and represent differences on a number line.

Stage 1 - Desired Results
<u>**Minnesota Mathematics Academic Standards**</u> ● *2.1.1.1 Read, write and represent whole numbers up to 1000. Representations may include numerals, addition, subtraction, multiplication, words, pictures, tally marks, number lines and manipulatives, such as bundles of sticks and base 10 blocks.* ● *2.1.1.2 Use place value to describe whole numbers between 10 and 1000 in terms of hundreds, tens and ones. Know that 100 is 10 tens, and 1000 is 10 hundreds.* ● *2.1.1.5 Compare and order whole numbers up to 1000.* ● *2.1.2.1 Use strategies to generate addition and subtraction facts including making tens, fact families, doubles plus or minus one, counting on, counting back, and the commutative and associative properties. Use the relationship between addition and subtraction to generate basic facts.* ● *2.1.2.2 Demonstrate fluency with basic addition facts and related subtraction facts.* ● *2.1.2.4 Use mental strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers. Strategies may include decomposition, expanded notation, and partial sums and differences.* ● *2.1.2.5 Solve real-world and mathematical addition and subtraction problems involving whole numbers with up to 2 digits.* ● *2.2.2.2 Use number sentences involving addition, subtraction, and unknowns to represent given problem situations. Use number sense and properties of addition and subtraction to find values for the unknowns that make the number sentences true.*   <u>**Unit Objectives**</u> <u>Math Objectives</u> ● Students subtract fluently within 20. (2 days) ● Students represent and solve 2-digit subtraction equations that require no regrouping. ● Students represent and solve 2-digit subtraction equations that require regrouping. ● Students use a number line to subtract.

- Students decompose one number by place value to subtract 2-digit numbers.
- Students adjust numbers to subtract.
- Students use addition to solve 2-digit subtraction equations.
- Students solve one-step word problems within 100 using subtraction.
- Students solve two-step word problems within 100 using subtraction.

Language Objectives
- Students discuss how to subtract fluently within 20 while answering *Wh-* questions and Yes/No questions.
- Students discuss more strategies to subtract fluently within 20 using the verbs *make* and *use*.
- Students explain how to solve 2-digit subtraction equations without regrouping while answering *Wh-* questions.
- Students explain how to solve 2-digit subtraction equations with regrouping while answering *Wh-* questions.
- Students talk about how to use a number line to subtract while answering *Wh-* questions.
- Students talk about decomposing by place value to subtract while using the term *difference*.
- Students explain how to adjust numbers to subtract using *must*.
- Students explain how to use addition to solve 2-digit subtraction equations while answering while answering *Wh-* questions.
- Students discuss solving one- step subtraction word problems within 100 while answering *Wh-* questions.
- Students talk about solving two-step subtraction word problems using *would* and *could*.

Adapted from McGraw Hill- Reveal.

Meaning

Understanding (U): *What kinds of long-term independent accomplishments are expected?*
- Counting on, counting back, making a 10, and using addition can help me subtract within 20.
- Place value can help me subtract 2-digit numbers.
- Decomposing numbers, adjusting numbers, and using addition to subtract can make subtraction with 2-digit numbers simpler.
- I can use different subtraction strategies to solve one- and two-step word problems.

Essential Questions (Q): *What thought-provoking questions will foster inquiry, meaning making meaning and transfer?*
- Where do I see subtraction in the real world?
- How do I recognize what strategy to use for a specific problem?
- What strategies can I use to compute sums and differences mentally?
- How can I decompose numbers in order to more efficiently add numbers together?
- How does knowledge of place value help with subtraction?
- How can the relationship between addition and subtraction help with problem solving?

Students will know…(Knowledge) *(Noun phrases-facts and basic concepts to recall)*
- Subtraction is taking a number away from a given number or determining the difference between two numbers in comparison problems.
- Numbers can be decomposed in many ways.
- There are many different strategies that can be used to solve the same subtraction problem.
- Every addition fact has a related subtraction fact, and vice versa (fact families).
- The equal sign (=) is a symbol that means the total amount on one side of the sign is the same as the total amount on the other side.
- Subtraction problems can be represented in many ways (concrete, pictorial, and abstract representations).
- Numbers can be adjusted to make it simpler to subtract.
- Regrouping requires exchanging a ten for ten ones.

Students will be able to … (Skills) (I can statements)
(Verb phrases-discrete skills and processes to use)
- Recall subtraction facts
- Identify a missing number
- Represent subtraction problems in multiple ways (concrete, pictorial, abstract).
- Use strategies (doubles, count on, count back, make a 10, decompose, addition strategies) to subtract.
- Identify related addition expressions to solve subtraction facts, as well as identify related subtraction expressions to solve addition facts
- Identify subtraction expressions to solve given word problems
- Recall subtraction facts to solve word problems
- Adjust numbers to subtract efficiently
- Solve two-digit subtraction problems with and without regrouping
- Check my answers by using addition

Stage 2 - Assessment Evidence

Performance Tasks (T): *How will meaning making and transfer be demonstrated? (Summative Assessment)*

Pre-assessment/Readiness Diagnostic

Assessment Options:
Post-assessment

Create a song, poem, or rap to demonstrate your knowledge of one or more of the following subtraction strategies:
- Counting back

- Counting up
- Making a 10 to subtract
- Decomposing numbers
- Adjusting numbers
- Doubles
- Fact Families
- Subtracting 2-digit numbers
- Subtracting 2-digit numbers with regrouping

Other Evidence (OE): *What tasks/activities determine whether desired results have been accomplished? Formative Assessments DOK1-2*
1. Exit Slips
2. Independent Practice
3. Observation
4. Conversations (peer-to-peer and student to teacher)
5. Teacher-Created Check-ins
6. Self-reflection

Stage 3 - Learning Plan

Learning Activities (L): *What is the goal for each activity, task, event?*

[Daily Lesson Plan Examples](#)

Anticipated time span for teaching this unit: 16 Days

Core Unit Vocabulary

Math Terms
- Count on
- Count back
- Decompose
- Difference
- Regroup
- Number line
- Place value
- Adjust
- Friendly numbers
- Related facts

*New terms for second graders

Academic Terms

- Different
- Prefer
- Process
- Represent
- Explain
- Information
- Check
- Relate
- Similar
- Argument
- Compare
- Check
- Make sense
- Require
- Information

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