

**Dance as an Educational Tool**

by

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## **Abstract:**

The following paper describes a multistep instructional program for implementing art-based teaching and learning. As part of the program, dance is used as a catalyst, in conjunction with standard didactic instruction, to teach fundamental mathematical concepts to elementary school students. This collaborative learning technique was designed with the belief that cross-disciplinary learning facilitates improved comprehension. Through targeting several of the identified intelligences, this multimodal teaching strategy allows educators to provide multiple ways for students to derive deeper understandings, as learners who have been offered multiple modes of representation are able to increase their knowledge retention and in turn, develop strong critical thinking and problem-solving skills.

## **Introduction:**

In his 1983 publication, “Frames of Mind: The Theory of Multiple Intelligences”, developmental psychologist Howard Gardner, proposes his theory of multiple intelligences, eight possible preferred learning styles that an individual may possess. They include linguistic intelligence, logical-mathematical intelligence, spatial intelligence, musical intelligence, bodily-kinesthetic intelligence, naturalistic intelligence, interpersonal intelligence, and intrapersonal intelligence (Gardner, 1983). His theory seeks to explore the ways in which individuals employ these various intelligences to effectively solve problems and function in a given environment, while also challenging the ideology of intelligence as a single quantitative entity.

As defined by one’s ability to use their body to create or solve problems, bodily-kinesthetic intelligent individuals possess exemplary control and awareness of their bodily motions and relation to space, demonstrating a strong sense of physical prowess. The listed competencies allow kinesthetically intelligent individuals to pursue careers in athletics, dance, physical therapy, and various other occupations that require a level of manual dexterity. Whereas, logical-mathematical intelligent individuals demonstrate a high level of proficiency in their ability to develop and improve equations and solve abstract problems. Individuals with logical-mathematical intelligence often succeed as accountants, computer analysts, bankers, engineers, and various other careers requiring scientific reasoning.

In more recent years, with the adaptation of specific and highly focused educational standards, there has been an increased amount of focus put into competing globally on an educational level. However, as the methodology used to aid in the student's development of strong conceptual understandings fails to incorporate the individual ways in which students learn, there is, in turn, a loss in their attention and thus their understanding (Wood, 2008). In expanding pre-existing theories relating to practical general intelligence possessing a thorough understanding of the various intelligences will allow educators to effectively and efficiently target the numerous cognitive potentials.

Active learning targets linguistic, musical, spatial, and bodily-kinesthetic intelligences which in total is four out of the eight identified intelligences. Prior research has shown that active learning is more effective than traditional methods in providing an in-depth understanding of learning standards (Minton, 2003). As learning through doing encourages involvement it allows students to actively construct knowledge and develop their own effective links, thus promoting a deeper understanding of the educational content, and as a result greater durability of knowledge retention (Minton, 2003).

Generally, dance incorporates various shapes, symmetrical patterns, and spatial patterns, therefore, demonstrating a strong relationship to geometry. For example in ballet 90 degree first arabesque is comprised of two parallel lines, with the working leg and arms parallel to the floor, and one perpendicular line, with the standing leg perpendicular to the working leg , here not only can one analyze the lines of the body and how they relate to one another , but also the dancer's relationship to the space in which they exist. Individually each dancer forms unique shapes and

patterns. One can even identify the various physical transformations, rotations, mirror reflections, translation, in a given work.

With its unique approach to the learning process, dance education appeals to various types of learners. It targets physical, emotional, communication, creative and cognitive skills, all of which are imperative during developmental years.

In my research I seek to explore how dance can be used as an educational tool to teach fundamental mathematical concepts, thus using kinesthetics as a means to inform logistics. Mathematician Seymour Papert understood the relationship between motion and memory, in stating, “If we act out what we think, then the mind has richer information from which to make connections with previous experience, and from which to develop memory, and a deeper connection with the event.” In developing a dance-based program of learning based on the pre-existing fundamental mathematics common core standards, my research will explore how dance can be used as an educational tool.

Although several studies have been previously conducted investigating the relationship between active teaching/learning and academic performance, the research results have been found to be inconclusive, as the studies failed to demonstrate a notable impact on test performance with the implementation of a dance-education based program. Even fewer studies have investigated how active learning-based instruction can be effectively incorporated into the educational system. Prior studies have yet to establish a significant relationship between dance and math, and such studies are key to understanding how dance can be effectively incorporated into an active learning-based program.

In previous years, with the United States having demonstrated a lack of mathematical proficiency, international models of mathematical standards have been adapted with the intentionality of creating a more focused curriculum, thus enabling students to compete globally. Standing as the formative years of one's education, kindergarten, first grade, and second-grade curriculum have been purposefully designed to provide a strong foundation in fundamental concepts. This is not only imperative for the manner in which students view math but also their fundamental understanding. Instructional time should concentrate on their conceptual understanding of key principles. Educators should concern themselves with giving purpose to learning objectives, in order to construct deeper understandings, such as dance education seeks to achieve (Minton, 2003). Using dance as a stimulant to actively involve students encourages teamwork, creativity and communication, which then allows students to create their own individual connections (Wood, 2008). Compared to didactic instruction, an integrated curriculum ensures a demonstration of real-world application which is essential for establishing deeper understandings, as students are more likely to actively engage themselves in the curricula if they find it to be meaningful. Which may then reduce the innate fear many individuals face when confronted with numbers (Wood, 2008).

## **Methods:**

Based on the pre-existing fundamental mathematics common core standards, elementary mathematics curricula should concentrate on four core areas, including the concept of the number( operations and number relations), geometry ( spatial relations and measurement), and

real-world applications of the learned concepts (National Governors Association and Council of Chief State School Officers, 2010). Following the completion of each grade level students should be able to analyze, conceptualize, demonstrate procedural fluency, and communicate each learned concept (National Governors Association and Council of Chief State School Officers, 2010). I have thus devised a specific instructional program effectively implementing dance into the mathematics curriculum, to further reinforce learned standards. Each of these exercises are designed with intentionality of achieving the aims of mathematical proficiency including communication, adaptive reasoning, and conceptual understanding (Wood, 2008). In implementing principles of constructivist learning, which suggests that individuals are responsible for actively constructing knowledge and assigning meaning to learned concepts, students are encouraged to communicate, exchange understandings, knowledge, experiences, and construct meaning, from which they may then devise new knowledge, as personal construction of meaning by the learner through experience, allows for deeper understanding and long-term retention of information (Wood, 2008).

The instructional program I have devised is based on the principles of art integrated curriculum. It is imperative that a distinction is made between art enhanced education and art integrated education. An art enhanced education uses art as the modality to support previously learned concepts, without designating explicit objectives in the art form, such as repeating the ABCs to remember the alphabetic sequence, without learning any musical skills (Zhou, 2018). Whereas an art integrated curriculum uses art as the vehicle for learning thus, requiring students to create something original and of value. Art integration is larger than a simple coloring exercise, it is an approach to teaching that draws on student's prior knowledge to create an



authentic context for students to be engaged in the creative process, in order to increase understandings in both subject areas (Zhou, 2018). Educators are required to set mutually reinforcing objectives in both the specific art and curriculum area, while students are challenged to derive unique connections and demonstrate it using art, as opposed to memorizing material and testing knowledge retention in a traditional manner (Zhou, 2018).

## Counting & Cardinality:

This overall lesson has been structured with the intention that students will shift from reciting the numerical sequence from memory to counting and comparing the number of objects in a set, using specific mathematic vocabulary (less than, greater than, and equal to, odd, even). Having gained a deeper understanding of the numerical sequence, students will also begin to mentally solve simple addition and subtraction equations within three-digit numbers.

### Guiding Questions

#### Kindergarten : Figure 1

1. Count forward from a specified number (within 0-20)
2. Group multiples of 2, 5, and 10 within 100
3. Using One-to-one correspondence assign one number to each object
4. Count the total number of objects in each set
5. Compare the number of objects in each set using the terms, less than, greater than, and equal to

#### 1st Grade : Figure 2

1. Count forward from a specified number (within 0-120)
2. Fill in each missing number
3. For each given number compare them based on meanings of the tens and one's digits using the terms, less than, greater than, and equal to
4. For each given number, mentally calculate 10 more or 10 less than the number
5. Subtract multiples of 10 for each given number beginning with 11







#### 2nd Grade : Figure 3

1. Count forward from a specified number (within 0-500)
2. Complete the given equations
3. For each specified number compare them based on meanings of the hundreds, tens and one's digits using the symbols ( $>$ ,  $=$ , and  $<$ )

Name \_\_\_\_\_

# COUNT Compare & Write

Count each object and write the number in the correct box.

	<input type="text"/>		<input type="text"/>		<input type="text"/>
	<input type="text"/>		<input type="text"/>		<input type="text"/>

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Figure 1: Kindergarten Work sheet

**100**

Name \_\_\_\_\_

Number Worksheet

## Count to One Hundred (100)

Practice counting to one hundred (100) by filling in the missing numbers below.

1	2						8		
11					16				
		23						29	
						37			
				45					
	52								60
			64						
71							78		
	82				86				
		93						99	

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**Figure 2: 1<sup>st</sup> Grade Work sheet**

## Adding and Subtracting to 99 (A)

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Calculate each sum or difference.

$$\begin{array}{r} 80 \\ +12 \\ \hline \end{array}$$

$$\begin{array}{r} 87 \\ -27 \\ \hline \end{array}$$

$$\begin{array}{r} 76 \\ +23 \\ \hline \end{array}$$

$$\begin{array}{r} 83 \\ -13 \\ \hline \end{array}$$

$$\begin{array}{r} 20 \\ +27 \\ \hline \end{array}$$

$$\begin{array}{r} 62 \\ -39 \\ \hline \end{array}$$

$$\begin{array}{r} 22 \\ +10 \\ \hline \end{array}$$

$$\begin{array}{r} 51 \\ -36 \\ \hline \end{array}$$

$$\begin{array}{r} 19 \\ +38 \\ \hline \end{array}$$

$$\begin{array}{r} 53 \\ -34 \\ \hline \end{array}$$

$$\begin{array}{r} 15 \\ +18 \\ \hline \end{array}$$

$$\begin{array}{r} 63 \\ -51 \\ \hline \end{array}$$

$$\begin{array}{r} 58 \\ +20 \\ \hline \end{array}$$

$$\begin{array}{r} 99 \\ -12 \\ \hline \end{array}$$

$$\begin{array}{r} 30 \\ +43 \\ \hline \end{array}$$

$$\begin{array}{r} 59 \\ -22 \\ \hline \end{array}$$

$$\begin{array}{r} 19 \\ +13 \\ \hline \end{array}$$

$$\begin{array}{r} 57 \\ -47 \\ \hline \end{array}$$

$$\begin{array}{r} 26 \\ +26 \\ \hline \end{array}$$

$$\begin{array}{r} 63 \\ -33 \\ \hline \end{array}$$

$$\begin{array}{r} 51 \\ +23 \\ \hline \end{array}$$

$$\begin{array}{r} 37 \\ -27 \\ \hline \end{array}$$

$$\begin{array}{r} 24 \\ +69 \\ \hline \end{array}$$

$$\begin{array}{r} 66 \\ -45 \\ \hline \end{array}$$

$$\begin{array}{r} 68 \\ +24 \\ \hline \end{array}$$

**Figure 3: 2nd Grade Work sheet**

## **Counting & Cardinality: Kindergarten**

An active learning-based education system

**Grade:** Kindergarten

**Curriculum Focus:** Counting

### **Common Core Mathematics Standards addressed:**

Count to 100 using groupings of ones and tens.

CCSS.MATH.CONTENT.K.CC.A.2

Count forward beginning from a given number within the known sequence (instead of having to begin at 1).

CCSS.MATH.CONTENT.K.CC.A.3

### **National Core Dance Standards addressed:**

Respond in movement to a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance).

DA:Cr1.1.K

Explore different ways to do basic locomotor and non-locomotor movements by changing at least one of the elements of dance.

DA:Cr1.1.K

Express an idea, feeling, or image, through improvised movement moving alone or with a partner

DA:Cr2.1.K

### **Learning Objectives:**

Students will have a thorough understanding of the counting number sequence.

Allowing them to:

- Write numbers from 0 to 100.
- Count a selected number of objects
- Group multiples of 2, 5, and 10 within 100

### **Exercise:**

#### Number Hopscotch:

Collaboratively students will construct a number related phrase

1. Students will have already completed the above, guided exercises
2. The instructor will partition the students into two groups
  - An observing group
  - An active group

3. The instructor will call out numbers randomly from 1-100
  - **Round 1 Multiples of 2:** On each multiple of two students must complete a leg movement
  - **Round 2 Multiples of 5:** On each multiple of five students will change their direction in the room
  - **Round 3 Multiples of 3 and 10:** On each multiple of three students will make an arm gesture and on each multiple of ten students will high five their neighbor
  - Students will be given a paper with a selection of numbers
4. **Bonus round:** Using the guidelines from multiples of 2,5, and 3 students must also incorporate level change
5. Following the exercise, the observing group will discuss their observations



# Counting & Cardinality: Grade 1

An active learning-based education system

**Grade:** 1st Grade

**Curriculum Focus:** Counting

## **Common Core Mathematics Standards addressed:**

Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral.

CCSS.MATH.CONTENT.1.NBT.A.1

Understand place value.

CCSS.MATH.CONTENT.1.NBT.B.2

Understand that the two digits of a two-digit number represent amounts of tens and ones.

Understand the following as special cases: The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones).

CCSS.MATH.CONTENT.1.NBT.B.2.C

## **National Core Dance Standards addressed:**

Explore movement inspired by a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance, experiences) and identify the source

DA:Cr1.1.1

Explore a variety of locomotor and non-locomotor movements by experimenting with and changing the elements of dance.

DA:Cr1.1.1

Choose movements that express an idea or emotion, or follow a musical phrase

DA:Cr2.1.1

## **Learning Objectives:**

After demonstrating an understanding of the use of the place value system and the related operations students will be able to explain the reasoning used

Allowing them to:

- Compare two two-digit numbers based on meanings of the tens and one's digits
- Use place value understanding and properties of operations to add and subtract.
- Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, explain the reasoning used
- Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count.

- Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.

**Exercise:**

**The Number Dance:**

Collaboratively students will construct a number related phrase

1. Students will have already completed the above, guided exercises
  2. The instructor will partition the students into three groups
  3. Collectively, in the assigned groups, students will be given 10 minutes to choreograph a short 10 count phrase using the five elements of dance ( body, action, time, space, and energy).
    - Each movement must have its own number
1. The instructor will then call out a number from 1-100, and using the choreographed phrase students will complete their choreographed movement
  1. The exercise will be completed in the small groups and the remaining students will serve as the observing group
    1. During the initial practice round, the instructor will call out numbers 0-10, where 0 is a neutral position, and students will complete each movement according to the number called
    1. During the next few rounds, the instructor will call out numbers 0-100, where 0 is once again a neutral position, as the choreographed phrase is only 10 counts
    1. **Round 1 Multiples of 2:** On each multiple of two students will complete either of the movements associated with counts 2,4,6,8 or 10, thus allowing for a wide variety of movement options
    1. **Round 2 Multiples of 3:** On each multiple of three students will complete either of the movements associated with count 3,6 or 9
    1. **Round 3 Multiples of 4:** On each multiple of four students will complete either of the movements associated with counts 4 or 8
    1. **Round 4 Multiples of 5:** On each multiple of five students will complete either of the movements associated with counts 5 or 10
    1. **Round 5 Multiples of 6:** On each multiple of six students will complete the movement associated with count 6
    1. **Round 6 Multiples of 7 and 8:** On each multiple of six students will complete either of the movements associated with counts 7 or 8
    2. **Round 7 Multiples of 9 and 10:** On each multiple of six students will complete either of the movements associated with counts 9 or 10
  3. Following the exercise, the observing group will discuss their observations

## **Counting & Cardinality: Grade 2**

An active learning-based education system

**Grade:** 2nd Grade

**Curriculum Focus:** Counting

### **Common Core Mathematics Standards addressed:**

Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and one

CCSS.MATH.CONTENT.2.NBT.A.1.A

100 can be thought of as a bundle of ten tens — called a "hundred."

CCSS.MATH.CONTENT.2.NBT.A.1.B

The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundred (and 0 tens and 0 ones).

CCSS.MATH.CONTENT.2.NBT.A.2

### **National Core Dance Standards addressed:**

Explore movement inspired by a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance, experiences) and suggest additional sources for movement ideas.

DA:Cr1.1.2

Combine a variety of movements while manipulating the elements of dance.

DA:Cr2.1.2

Choose movements that express a main idea or emotion or follow a musical phrase. Explain reasons for movement choices.

DA:Cr2.1.2

### **Learning Objectives:**

Students will be able to read and write numbers to 1000 using base-ten numerals, number names, and expanded form.

Allowing them to:

- Use symbols (using  $>$ ,  $=$ , and  $<$ ) to identify and compare two three-digit numbers based on meanings of the hundreds, tens, and ones
- Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
- Understand place value.

- Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method.
- Mentally add 10 or 100 to a given number 100-900, and mentally subtract 10 or 100 from a given number 100-900.

### **Exercise:**

#### **The Number Dance:**

Collaboratively students will construct a number related phrase

1. Students will have already completed the above, guided exercises
  2. The instructor will partition the students into three groups
  3. Collectively, in the assigned groups, students will be given 10 minutes to choreograph a short 10 count phrase using the five elements of dance ( body, action, time, space, and energy).
    - Each movement must have its own number
1. The instructor will then call out a number from 1-100, and using the choreographed phrase students will complete their choreographed movement
  1. The exercise will be completed in the small groups and the remaining students will serve as the observing group
  1. During the initial practice round, the instructor will call out numbers 0-10, where 0 is a neutral position, and students will complete each movement according to the number called
  1. During the next few rounds, the instructor will call out numbers 0-100, where 0 is once again a neutral position, as the choreographed phrase is only 10 counts
  1. **Round 1 Multiples of 2 and 3:** On each multiple of two students will complete either of the movements associated with counts 2,4,6,8 or 10, thus allowing for a wide variety of movement options and on each multiple of three students will complete either of the movements associated with count 3,6 or 9
  1. **Round 2 Multiples of 4 and 5:** On each multiple of four students will complete either of the movements associated with counts 4 or 8 and on each multiple of five students will complete either of the movements associated with counts 5 or 10
  1. **Round 3 Multiples of 6,7,8:** On each multiple of six students will complete the movement associated with count 6 and on each multiple of six students will complete either of the movements associated with counts 7 or 8
  1. **Round 4 Multiples of 9 and 10:** On each multiple of six students will complete either of the movements associated with counts 9 or 10
  1. **Round 5,** While in the same small groups the instructor will call out simple addition and subtraction equations within 1-20, (i.e.: 5+4) students will then be required to individually calculate the answer and produce a movement associated with the resulting answer
    - 1. Multiples of 2, 3
    - 2. Multiples of 4,5
    - 3. Multiples of 6,7,8
    - 4. Multiples. of 9,10

## **Operations and Algebraic Thinking:**

This overall lesson has been structured with the intention that students will be able to efficiently solve multistep addition and subtraction word problems within three-digit numbers.

### **Guiding Questions**

Kindergarten: Figure 4

1. Solve the given exercises

1st Grade: Figure 5



1. Solve the given exercises

2nd Grade: Figure 6



1. Solve the given exercises

## Word Problems

- 1) Mary has 3 bananas and 4 cherries. How many fruits does she have in all?

 $\square + \square = \square$ 

- 2) There are 4 orange slices in a plate. Pam adds 4 more. How many orange slices are there in the plate now?

 $\square + \square = \square$ 

- 3) Tina has 5 candies. Rosy has 4 candies. How many candies they have in all?

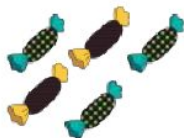
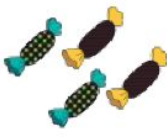
 $\square + \square = \square$ 

Figure 4: Kindergarten Worksheet

## Word Problems

- 1) Sara ate 3 slices of pizza. Jack ate 5. How many slices of pizza did they eat altogether?



- 2) John has 3 pair of black socks, 4 of white and 2 of blue socks. How many pairs of socks does he have in all?



- 3) There are 35 apples on the tree and 23 on the ground. How many apples are there in all?



- 4) There are 5 cows, 3 sheep and 14 goats at a farm. How many animals are there in all?



Figure 5 : 1<sup>st</sup> Grade Worksheet

## Word Problems

- 1) In a jungle, there are 5 lions, 5 elephants and 20 deer. How many animals are there in the jungle? \_\_\_\_\_
- 2) Peter has two boxes of chocolates. There are 25 chocolates in one box and 15 in another. How many chocolates does he have in all? \_\_\_\_\_
- 3) Sam went to a park. 3 girls were already playing there. 2 more boys came later. How many children are there in the park now? \_\_\_\_\_
- 4) Sona buys 10 pencils. Mona buys 2 more pencils than what Sona bought. How many pencils they have altogether? \_\_\_\_\_
- 5) Ram has 6 blue, 7 red and 8 yellow balls. How many balls does he have? \_\_\_\_\_
- 6) There are 34 roses and 45 sunflowers in my garden. How many flowers are there in all? \_\_\_\_\_
- 7) John weights 22 kilograms. Mary weights 17 kilograms. How much they weigh altogether? \_\_\_\_\_

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**Figure 6 : 2nd Grade Worksheet**



## **Operations and Algebraic Thinking: Kindergarten**

An active learning-based education system

**Grade:** Kindergarten

**Curriculum:** Operations

### **Common Core Mathematics Standards addressed:**

When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object.

CCSS.MATH.CONTENT.K.CC.B.4.A

Understand that each successive number name refers to a quantity that is one larger.

CCSS.MATH.CONTENT.K.CC.B.4.C

Represent addition and subtraction with objects, fingers, mental images, drawings<sup>1</sup>, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations.

CCSS.MATH.CONTENT.K.OA.A.1

### **National Core Dance Standards addressed:**

Respond in movement to a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance).

DA:Cr1.1.K

Explore different ways to do basic locomotor and non-locomotor movements by changing at least one of the elements of dance.

DA:Cr1.1.K

Express an idea, feeling, or image, through improvised movement moving alone or with a partner

DA:Cr2.1.K

### **Learning Objectives:**

Students will understand addition as combining terms/adding to and subtraction as taking away from.

Allowing them to:

- Solve addition and subtraction word problems, and add and subtract within 10
- For any number from 1 to 9, find the number that makes 10 when added to the given number

## **Exercise:**

### Freeze Dance:

Collaboratively students will use movement and critical thinking skills to demonstrate and solve addition and subtraction word problems

1. Students will have already completed the above, guided exercises
2. The instructor will partition the students into small groups
  - An observing group
  - An active group
1. The instructor will present either a singular object or collection of objects in representation of a number, within 1-10
1. The instructor will then play a musical selection, with distinct beats, i.e: distinct claps
1. Students will then be required to dance out addition and subtraction equations that would result in the given number
1. The first round includes numbers and equations using 1-5
1. The second round includes numbers and equations using 6-10
1. The bonus round includes numbers and equations using numbers 1-10
1. An example round might look like the following:
  - i.e.: The instructor presents 5 objects
  - During this time the observing group of students will cover their eyes
  - While the active group of students is provided with 10 seconds to individually count the objects and quickly notate an addition and subtraction equation associated with the number
  - The observing group of students will then be required to uncover their eyes
  - The instructor will play the musical selection
  - One by one beginning with addition equations students will dance out their individual equations within 10 distinct beats of music
  - $(3+2)$  and  $(4+1)$  are clear examples of elementary addition equations within 10 that result in 5
  - In the case of  $4+1$ , a student may dance for four distinct beats stop and clap to show addition and dance for one more distinct beat
  - $(7-2)$ ,  $(8-3)$ ,  $(9-4)$ ,  $(10-5)$  and  $(6-1)$  are clear examples of elementary subtraction equations within 10 that result in 5
  - In the case of  $9-4$ , a student may dance for nine distinct beats stop and pose to show subtraction and dance for four more distinct beats
  - The above exercises will be repeated for numbers 6-10
2. As a class, the students will discuss all addition and subtraction equation possibilities for each of the numbers presented
3. The observing group of students will then be required to guess the number associated with the number of objects presented based on their observations



# Operations and Algebraic Thinking: Grade 1

An active learning-based education system

**Grade:** 1st Grade

**Curriculum:** Operations

**Blurb:**

## **Common Core Mathematics Standards addressed:**

Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.1

CCSS.MATH.CONTENT.1.OA.A.2

Solve word problems that call for the addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Understand and apply properties of operations and the relationship between addition and subtraction.

CCSS.MATH.CONTENT.1.OA.B.3

## **National Core Dance Standards addressed:**

Explore movement inspired by a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance, experiences) and identify the source

DA:Cr1.1.1

Explore a variety of locomotor and non-locomotor movements by experimenting with and changing the elements of dance.

DA:Cr1.1.1

Choose movements that express an idea or emotion, or follow a musical phrase

DA:Cr2.1.1

## **Learning Objectives:**

Students will organize and interpret data relating to number operations

Allowing them to:

- Apply properties of operations as strategies to add and subtract.
- Add and subtract within 20.

- Demonstrate fluency for addition and subtraction within 10.
- Relate counting to addition and subtraction, and working with addition and subtraction equations, determine if the equations are true or false.

**Exercise:**

**Freeze Dance:**

Collaboratively students will use movement and critical thinking skills to demonstrate and solve addition and subtraction word problems

1. Students will have already completed the above, guided exercises
2. The instructor will partition the students into small groups
  - An observing group
  - An active group
1. The instructor will present either a singular object or collection of objects in representation of a number, within 1-20
  1. The instructor will then play a musical selection, with distinct beats, i.e: distinct claps
  1. Students will then be required to dance out addition and subtraction equations that would result in the given number
    1. The first round includes numbers and equations using 1-10
    1. The second round includes numbers and equations using 11-20
    1. The bonus round includes numbers and equations using numbers 1-20
    1. An example round might look like the following:
      - i.e.: The instructor presents 5 objects
      - During this time the observing group of students will cover their eyes
      - While the active group of students is provided with 20 seconds to individually count the objects and quickly notate an addition and subtraction equation associated with the number
      - The observing group of students will then be required to uncover their eyes
      - The instructor will play the musical selection
      - One by one beginning with addition equations students will dance out their individual equations within 10 distinct beats of music
      - $(3+2)$  and  $(4+1)$  are clear examples of elementary addition equations within 10 that result in 5
      - In the case of  $4+1$ , a student may dance for four distinct beats stop and clap to show addition and dance for one more distinct beat
      - $(7-2)$ ,  $(8-3)$ ,  $(9-4)$ ,  $(10-5)$  and  $(6-1)$  are clear examples of elementary subtraction equations within 10 that result in 5
      - In the case of  $9-4$ , a student may dance for nine distinct beats stop and pose to show subtraction and dance for four more distinct beats
      - The above exercises will be repeated for numbers 11-20
      - As a class, the students will discuss all of the addition and subtraction equation possibilities for each of the numbers presented
      - As a class, the students will discuss all of the addition and subtraction equation possibilities for each of the numbers presented

4. As a class, the students will discuss all of the addition and subtraction equation possibilities for each of the numbers presented the observing group of students will then be required to guess the number associated with the number of objects presented based on their observations

5. As a class, the students will discuss all the addition and subtraction equation possibilities for each of the numbers presented

## **Operations and Algebraic Thinking: Grade 2**

An active learning-based education system

**Grade:** 2nd Grade

**Curriculum:** Operations

### **Common Core Mathematics Standards addressed:**

Represent and solve problems involving addition and subtraction within 100  
CCSS.MATH.CONTENT.2.OA.A.1

Fluently add and subtract within 20 using mental strategies.  
CCSS.MATH.CONTENT.2.OA.A.2

### **National Core Dance Standards addressed:**

Explore movement inspired by a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance, experiences) and suggest additional sources for movement ideas.

**DA:Cr1.1.2**

Combine a variety of movements while manipulating the elements of dance.

**DA:Cr2.1.2**

Choose movements that express a main idea or emotion or follow a musical phrase. Explain reasons for movement choices.

**DA:Cr2.1.2**

### **Learning Objectives:**

Students will be able to solve singular and multi-step word problems involving situations of addition and subtraction

Allowing them to:

- Solve and analyze one and two-step word problems involving situations of addition and subtraction within 100

### **Exercise:**

## Number Song and Dance:

Collaboratively students will use movement and critical thinking skills to demonstrate and solve addition and subtraction word problems.

1. Students will have already completed the above, guided exercises
2. The instructor will partition the students into small groups
  - An observing group
  - An active group
1. The instructor will present a number, within 1-100
1. The instructor will then play a musical selection, with distinct beats, i.e: distinct claps
1. In groups, students will then be required to dance out three-part addition and subtraction equation word problems that would result in the given number
1. The first round includes numbers and equations using 1-25
1. The second round includes numbers and equations using 26--50
1. The third round includes numbers and equations using numbers 51-75
1. The fourth round includes numbers and equations using numbers 76-100
1. The bonus round includes all numbers 1-100
1. An example round might look like the following:
  - i.e.: Students will pick a number
  - During this time the observing group of students will cover their eyes
  - After the observing group of students uncovers their eyes, in groups of three, the students will then be provided with 10 minutes create a three-part addition or subtraction word problem associated with the number
  - In the same small groups beginning with addition equations, students will perform their choreographed word problems
  - $(5+6+5)$ ,  $(8-6-4)$ ,  $(4+7+5)$  where each student represents a number
  - Student 1 = 5,8,4
  - Student 2=6,6,7
  - Student 3=5,4,5
  - “Fruit salad dance” Student 1 may sing “I have five apples (and count aloud) 1.2.3.4.5” ...and dance for five distinct beats stop and clap to show addition and student 2 will sing “... and I have six bananas 1.2.3.4.5.6.”.. and dance for six distinct beats and student 3 may sing “and I had five pears 1.2.3.4.5.”.. and dance for 5 distinct beats and clap and student 1 will start again with 8 and transition to subtraction
1. Based on their observations, the observing group of students will then be required to guess the number presented in each step of the word problem
1. As a class, the students will discuss other addition and subtraction equation possibilities for each of the numbers presented





# Geometry

This overall lesson has been structured with the intention that students will be able to classify shapes according to their defining attributes. Thus, allowing them to later analyze, differentiate, and categorize a variety of shapes based on those various attributes. Students will first be present a selection of varying two-dimensional geometric shapes from which they must then identify and explain the common and contrasting attributes. Following this exercise, students will be prompted to use their physical imagination to explore the previously identified shapes. Students will use their bodies to complete tasks that require them to describe the characteristics of a shape, such as the curvature of a circle, with their bodies.

## Guiding Questions

The following guided questions are to be paired with the corresponding worksheet.

### Classifying Geometric Shapes: Kindergarten : Figure 7

1. Describe general attributes about each shape
2. Create two lists based on the above attributes
3. What is different about the shapes on each list?
4. What is the same about the shapes on each list?
5. Describe their position in space

### Classifying Geometric Shapes: 1st Grade : Figure 7

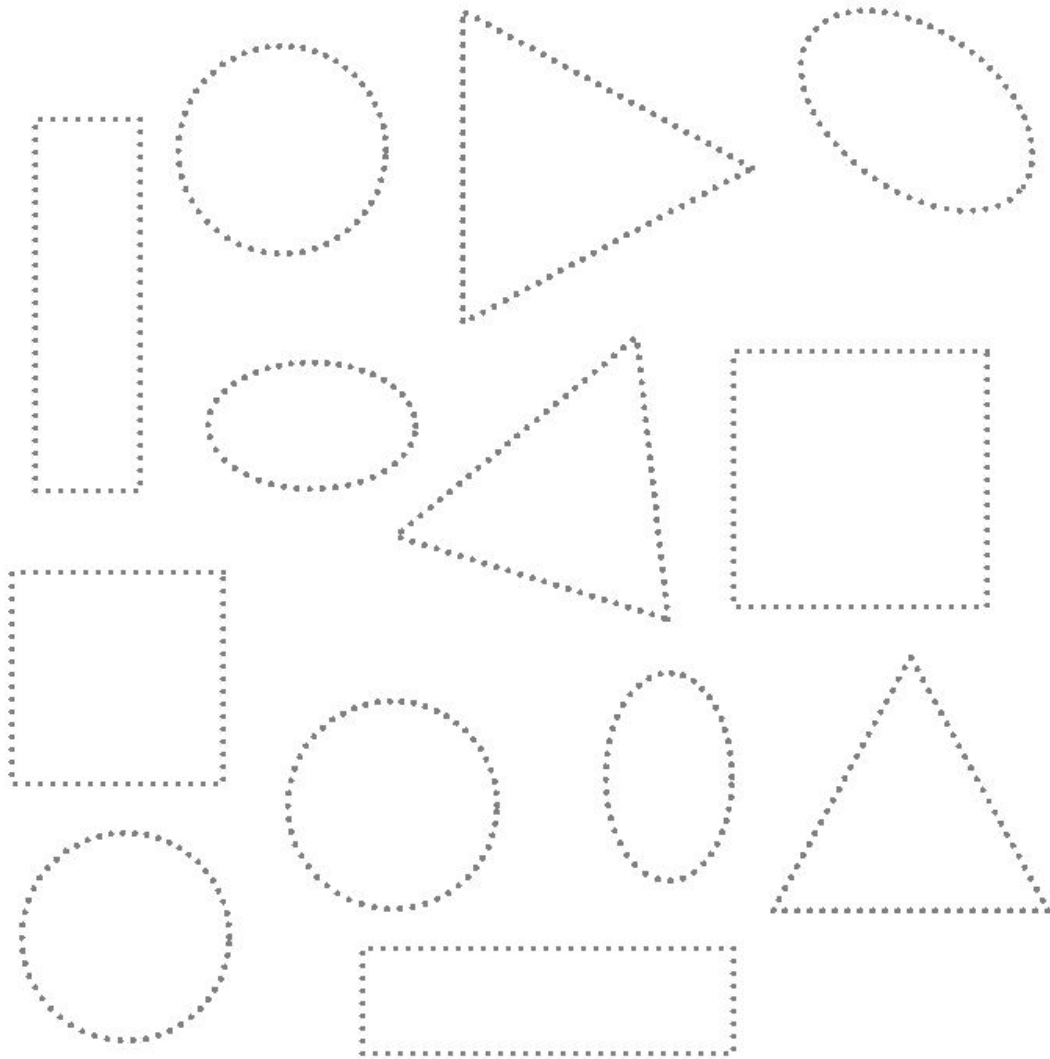
1. Identify all the shapes
2. Identify and describe the defining properties of each shape
3. Describe their position in space
4. Find two shapes that share no properties
5. Find two different shapes that share one or more property

### Classifying Geometric Shapes: 2nd Grade : Figure 7

1. Identify all the shapes
2. Describe their position in space
3. Identify and describe the defining properties of each shape
  - One pair of parallel sides
  - Two pairs of parallel sides
  - One pair of opposite sides that are the same length
  - Two pairs of opposite sides that are the same length
  - Four sides are the same length



Name: \_\_\_\_\_



**Shapes and Colors:** Trace the squares  $\square$  and color them blue.  
Trace the triangles  $\triangle$  and color them green.  
Trace the circles  $\bigcirc$  and color them red.  
Trace the rectangles  $\text{—}$  and color them orange.  
Trace the ovals  $\text{—}$  and color them purple.

Figure 7

## Geometry:

### Kindergarten

An active learning-based education system

**Grade:** Kindergarten

**Curriculum Focus:** Geometry

#### **Common Core Mathematics Standards addressed:**

Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as *above*, *below*, *beside*, *in front of*, *behind*, and *next to*.

CCSS.MATH.CONTENT.K.G.A.2

Correctly name shapes regardless of their orientations or overall size

CCSS.MATH.CONTENT.K.G.B.6

Compose simple shapes to form larger shapes. *For example, "Can you join these two triangles with full sides touching to make a rectangle?"*

#### **National Core Dance Standards addressed:**

Respond in movement to a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance).

DA:Cr1.1.K

Explore different ways to do basic locomotor and non-locomotor movements by changing at least one of the elements of dance.

DA:Cr1.1.K

Express an idea, feeling, or image, through improvised movement moving alone or with a partner

DA:Cr2.1.K

Depict a dance movement by drawing a picture or using a symbol.

DA:Cr3.1.K

#### **Learning Objectives:**

Students will be able to describe and model shapes in the world by using objects or drawings

Allowing them to:

- Identify shapes as two-dimensional or three-dimensional.

#### **Exercise:**

##### Shape Dance:

Students will use their bodies to construct static shapes in various positions in space

1. Students will begin by completing the above, guided exercises
2. The instructor will then divide the class into two groups
  - The first group will be composed of observing students
  - The second group will be composed of active students
1. The second group of students (active students) will begin in a neutral position, spread out in the space
  1. Instructors will provide students with up to 7 seconds to create a shape that was previously explored during the guiding exercises
  1. Individually students will use their bodies to create contrasting shapes that vary in size, direction, and level (on the ground, in the air, on a table, next to the wall)
  1. In pairs, students will repeat steps 3 and 4
  1. Observing students must then analyze and describe the shape and its position in space i.e.: above, below, besides, and behind based on the definitive qualities of the shapes explored during the guided exercises
2. Change groups and repeat the process

# Geometry: Grade 1

An active learning-based education system

**Grade:** 1st Grade

**Curriculum Focus:** Geometry

## **Common Core Mathematics Standards addressed:**

Distinguish between defining attributes build and draw shapes

CCSS.MATH.CONTENT.1.G.A.2

## **National Core Dance Standards addressed:**

Explore movement inspired by a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance, experiences) and identify the source

DA:Cr1.1.1

Explore a variety of locomotor and non-locomotor movements by experimenting with and changing the elements of dance.

DA:Cr1.1.1

Choose movements that express an idea or emotion, or follow a musical phrase

DA:Cr2.1.1

Depict several different types of movements of a dance by drawing a picture or using a symbol (for example, jump, turn, slide, bend, reach).

DA:Cr3.1.1

## **Learning Objectives:**

Students will be able to recognize and differentiate shapes based on their specific geometric attributes,

Allowing them to:

- Compose two and three-dimensional shapes
- Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters* and use the phrases *half of*, *fourth of*, and a *quarter of*. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.

## **Exercise:**

### Shape Dance:

Students will use their bodies to construct static shapes in various positions in space

1. Students will have already completed the above, guided exercises

2. The students will begin in a neutral position, spread out in a singular line
  3. Instructors will provide students with up to 4 seconds to create a shape that was previously explored during the guiding exercises
  4. Individually students will use their bodies to create contrasting shapes that vary in size, direction, and level (on the ground, in the air, on a table, next to the wall)
    - The shape must contrast that of the student that went before them in terms of size, level, and type of shape
1. Once the exercise is completed altogether the students will analyze and describe their individual shape and its position in space i.e.: above, below, besides, and behind based on the definitive aspects of the shapes explored during the guided exercises in contrast with that of their neighbor

## **Geometry: Grade 2**

An active learning-based education system

**Grade:** 2nd Grade

**Curriculum Focus:** Geometry

### **Common Core Mathematics Standards addressed:**

Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.

CCSS.MATH.CONTENT.2.G.A.3

### **National Core Dance Standards addressed:**

Explore movement inspired by a variety of stimuli (for example, music/sound, text, objects, images, symbols, observed dance, experiences) and suggest additional sources for movement ideas.

**DA:Cr1.1.2**

Combine a variety of movements while manipulating the elements of dance.

**DA:Cr2.1.2**

Choose movements that express a main idea or emotion or follow a musical phrase. Explain reasons for movement choices.

**DA:Cr2.1.2**

Depict the levels of movements in a variety of dance movements by drawing a picture or using symbols (for example, high, middle, low).

**DA:Cr3.1.2**

### **Learning Objectives:**

Students will be able to identify and analyze shapes and their attributes.

Allowing them to:

- Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.1 Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

### **Exercise:**

#### **Shape Dance:**

Students will use their bodies to construct static shapes in various positions in space

1. Students will have already completed the above, guided exercises



2. The students will begin in a neutral position, spread out in a singular line
  3. Instructors will provide students with up to 4 seconds to create a shape that was previously explored during the guiding exercises
  4. Individually students will use their bodies to create contrasting shapes that vary in size, direction, and level (on the ground, in the air, on a table, next to the wall)
    - The shape must contrast that of the student that went before them in terms of size, level, and type of shape
1. Once the exercise is completed altogether the students will analyze and describe their individual shape and its position in space i.e.: above, below, besides, and behind based on the definitive aspects of the shapes explored during the guided exercises in contrast with that of their neighbor
  1. During the second round, students will have the added challenge of connecting with another student to form their contrasting shape in space i.e.: the first student forms a circle above their head and the second student uses the leg of the first student to compose a low-level rectangle
  1. Students will once again be required to discuss how their shape is contrasting to that of their neighbor
  1. During the final round, instructors will partition students into small groups (2-3 students) and assign each group both a two-dimensional (rectangle, triangle, and square, rhombus) and three-dimensional (cube, cone, sphere) shape
  1. Students will be given 5 minutes to write or draw
    - The original two-dimensional shape
    - A contrasting shape
    - One other shape that has similar geometric attributes as the assigned shape
    - Repeat the following steps with the three-dimensional shape
  1. Students will then be provided with 5 minutes to make a dance that is composed of the above elements
  1. Observing students will be given 2 minutes following the performance to write out the shapes that were portrayed, definitive geometric attributes of the shapes portrayed, and how the shapes were similar or contrasted from one another

## **Discussion:**

After collecting a copious amount of information relating to the use of dance in mathematics education, I have deduced that the reason many arts-integrated educational programs are failing is largely due to the fact that educators are not setting goals for both subject areas (Zhou, 2018) . Thus, the programs lack clarity. Educators argue that it is challenging to incorporate arts-based activities in school, while simultaneously being required to successfully meet curriculum standards. It could also be hypothesized, that many educators do not consider the arts to be a valuable aspect of education because they believe there is no direct educational benefit in integrating the arts with distinct academic subjects (Zhou, 2018). Therefore, in order to combat this matter, mutually reinforcing interdisciplinary connections between the specific art form and curricula area must be made explicit. Ideally, educators in both disciplines should engage in developmental courses to learn more about arts education, and how to effectively collaborate and incorporate arts-integrated ideas into the curriculum (Zhou, 2018). In addition, students should also be required to engage in explicit arts instruction so that arts standards and specific mathematical content may become naturally aligned and assessed proportionately.

In order for arts-integrated programs to be successfully implemented educators must consider the following questions: What are the differences between using art as a resource vs full integration? What does it mean to perform fundamental mathematical concepts? How do I efficiently target both fields of study all the while maintaining their integrity? How can I thoughtfully demonstrate interdisciplinary connections (Zhou, 2018)? Implementing a

purposefully designed educational program that includes direct arts instruction will directly address the issue of the arts as purely for recreational purposes.

Few studies have successfully examined how the adoption of distinct mutually reinforcing learning objectives correlate to student achievement. To start, related course activities should be designed to address the multiple learning competencies of students. In turn, educators should reform progress monitoring tools to accommodate the experimental, problem solving, reflective and collaborative potentials of the arts. Examinations should concentrate on the real-world applications of the learned concepts, such as how mathematics can be used outside of the classroom. In the case of an elementary mathematics examination, a test may include a trip to the grocery store where students are provided with a predetermined budget and price list (educators may also require students to develop their own price list) for select grocery items, students are then required to calculate the maximum amount of items that may be purchased all the while staying within the budget. Questions such as the one described above challenge student's creativity which in turn increases their interest and as a result it leads to an increase in their performance. Further investigations may seek to explore the use of codified dance education in comparison to improvisational/choreography-based dance instruction and how arts integration be used to teach difficult math concepts.

## **Conclusion:**

I thoughtfully designed this arts-integrated educational program with the intention of challenging students to derive their own unique and original connections in both fields of study. Thus, I closely analyzed elementary national common core standards in both subjects so that valuable connections could be made between the two seemingly contrasting disciplines. In doing so, I realized that in order to maintain the integrity of both fields of study we must first re-define our preconceived beliefs of what math and dance are defined to be. We must relinquish the belief that mathematical proficiency is defined by one's ability to memorize and regurgitate facts. Alternatively, we should concern ourselves most with embracing every aspect of mathematics as a discipline, rather than confining it to a symbolic representation of a hermetical language. All the while simultaneously liberating the definition of dance to include all forms of movement, a movement that goes beyond codified dance vocabulary. In abandoning many of the obstinate ideologies associated with math and dance, I was able to establish commonalities between the two core subjects, and efficiently and effectively develop a learning system that reflected these ideals.

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