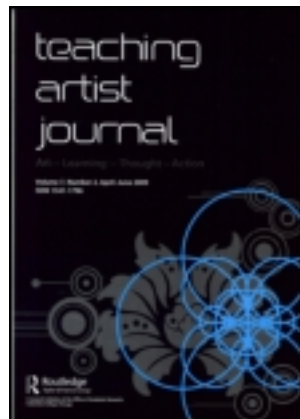


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## ABSTRACT

A dance teaching artist describes an innovative collaboration with an elementary school math teacher that leads to original student choreography and engaging mathematical thinking.

# Jump Patterns: Percussive Dance and the Path to Math

## Introduction

It's a Thursday morning, the fourth day of my residency at Fox Hill Elementary School in Indianapolis, Indiana. Two fifth-grade girls have created a four-count dance Pattern A. I ask what they plan to do for Pattern B and they tell me, "We're going to do Pattern A backwards." That is, instead of dancing beats 1, 2, 3, 4, they will reverse the order of their footwork, starting with beat 4 and finishing with beat 1. Pattern B will reflect the order of Pattern A. They also decide to sequence the two patterns as a BA combination, backward then forward—the AB combination turned inside out. Then, they will transform it using turn symmetry with one of them facing front and the other rotated 180°. This is mathematical thinking in action. Best of all, the girls are very proud of themselves and their creative work!

These girls, like most of my students, have no formal dance training, but they were nevertheless successful in creating their own original pieces of percussive dance choreography. They used a tool I created called Jump Patterns, which helped them learn the elements of percussive dance (step dance, clogging, tap, etc.) and then apply this understanding to create and sequence their own four-beat dance patterns. At the same time, they have strengthened their understanding of grade-appropriate math topics. By the end of five days with me, they are able to analyze and assess their peers' creative work by confidently using both dance and math terminology. They are also communicating their choreography through both performance and mapping. This is Math in Your Feet, an integration of traditional percussive dance and elementary-level mathematics.



(Credit: Jeff Hammond)

Malke Rosenfeld

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## Jump Pattern Origins

Math in Your Feet is firmly grounded in my work as a traditional percussive dancer, performing both Cape Breton step dance from Canada (by way of Scotland) and American "old-time" Appalachian flatfooting and clogging. These two forms lie stylistically between modern Irish step dance (known in one form from the show *Riverdance*) in which the arms and torso are held straight and stiff and the legs are active, and American tap dance where the entire body is

looser and moves more freely. The general similarities between different percussive dance forms include the use of percussive foot sounds for musical expression as well as more focus on movement in the legs and feet than in the upper body. What I have always brought to the table in my work with kids is what I believe to be the most important aspect of both Cape Breton step dance and Appalachian clogging: rhythm-making with the feet where the dancer quite literally becomes part of the music. I also value the fact that both styles celebrate



Malke Rosenfeld

Mid-flight.



We focus quite a bit on transformation and symmetry in this program and I try my best to make sure that, if asked, I can draw an accurate line of symmetry down the middle of our dance space. These are some drawings done by fourth graders as part of a thank-you letter project their teacher had them complete at the end of the residency (no one told them what to draw). Notice the basic symmetry of this space.

individual self-expression and encourage dancers to make their mark on the tradition by creating their own steps. Helping kids make up their own percussive dance patterns is at the heart of what I do as a teaching artist.

When I started bringing residencies and workshops into schools in 1997, my work with students had a much different focus. Schools in North and South Carolina, where I lived and worked, required fourth graders to learn about the cultures of their home states, including clogging. Traditional dance, as well as music of all styles, is often used to illustrate the culture and heritage of states, regions, or countries, and I taught with this cultural focus for many years.

However, I found that the fourth and fifth graders with whom I worked had very few musical or dance skills. Although my enthusiasm for the dance helped, they would quickly get overwhelmed, tired, or bored with too great a focus on technique. As I tried to address this issue, I found myself shifting from simply transmitting culture toward sharing my own creative processes as a performing and recording artist. I also knew I wanted to teach my students basic rhythmic concepts through percussive movement and provide them with the opportunity to create their own percussive dance patterns. The question was, how?

The answer came during the summer of 1999. I was teaching in an arts camp



I consider our dance space the "third teacher," as they say in the Reggio Emilia approach. I also sometimes call my use of tape "teaching below the surface." One of the below-the-surface learning tools in this program is that working with a friend and sharing ideas can lead to amazing results. Not only are these two girls dancing together (and smiling), they're dancing in a space delineated by blue tape!

## Record Your Patterns

Record your patterns in the chart below, using the best descriptive word in each category.

Pattern A	1	2	3	4
<b>FEET</b> Together Right Crossed Left Split	R	L	TOG	TOG
<b>MOVEMENT</b> Jump Hop Slide Turn Step Touch	ST	ST	J 90°	J 90°
<b>DIRECTION</b> Forward Back Diagonal R Side Center L Side	R FR DIAG	L FR DIAG	○	○
<b>PICTURE</b>				

Pattern B	1	2	3	4
<b>FEET</b> Together Right Crossed Left Split	TOG	TOG	SPLIT	TOG
<b>MOVEMENT</b> Jump Hop Slide Turn Step Touch	J 45°	J 90°	J	J
<b>DIRECTION</b> Forward Back Diagonal R Side Center L Side	○	○	L SPLIT DIAG	○
<b>PICTURE</b>				

These patterns were transcribed by the author from video footage of students performing their patterns. If you're trying to dance them, start with your feet together and read down each column instead of across each row.

at the ArtsCenter in my then hometown of Carrboro, North Carolina, and for some reason I can't recall now, I decided to teach my nine- and ten-year-old group some tinikling from the Philippines. In this tradition, as I understood it, two people create a rhythm by knocking two bamboo poles together and on the floor in a simple pattern. The dancers jump in and out of the poles using foot-based dance patterns.

When knocking bamboo poles became too precarious for both the dancers and the pole knockers, I decided to tape two long parallel lines on the floor so the kids could dance their patterns without the bruises. The kids made up their own four-beat patterns using this visual reference, and then we used the simple patterns to build our own dance to traditional Irish music. The children were ecstatic with the patterns/steps they had created. Their performance lit up the stage, and I knew I was onto something.

This experience at the Carrboro ArtsCenter was the birth of Jump Patterns. Since these are based on simple moves executed on the downbeat, they became the perfect solution to help me develop beat competency in my students. They also reflect the musical phrasing as well as many of the technical elements of traditional clogging and step dance steps. After that summer's success I started to use Jump Patterns as part of my school residencies. My program was still based in a cultural context and connected to a social studies curriculum, but now my ideas and processes as an artist were visible and more accessible to students.

## Map Your Pattern

With your partner, plot the position of your feet on either Pattern A or Pattern B. Record your movement and directions under each grid using only the symbols you created in your Map Key.

BEAT 1	BEAT 2
Movement: <u>ST</u> Direction: <u>RFR</u>	Movement: <u>ST</u> Direction: <u>LFR</u>
BEAT 3	BEAT 4
Movement: <u>J/T</u> Direction: <u>○/L90°</u>	Movement: <u>J/T</u> Direction: <u>○/R90°</u>

The mapping exercise is about using the symbolic language of math to communicate the dance patterns and follows on from the work and thinking done while filling out the *Record Your Pattern* charts. *Map Your Pattern* introduces four simple coordinate grids where students plot the position of their feet for each beat and then provide more information using symbols and/or abbreviations in the map key. Ideally, children will map one of their four-count patterns and then engage in a map exchange where another team tries to reproduce the pattern by reading the map.

***My hunch was that traditional percussive dance could build a bridge to increased understanding of a more abstract subject—math. I knew, however, that I needed an interpreter who would help me flesh out the real math happening naturally in the creative work I did with children.***

After about five years as a teaching artist, I started to wonder if there were other curricular connections I could make.

## The Path to Math

My hunch was that traditional percussive dance could build a bridge to increased understanding of a more abstract subject—math. I knew, however, that I needed an interpreter who would help me flesh out the real math happening naturally in the creative work I did with children. After telling anyone and everyone about my idea, I found just what I needed. Through Young Audiences of Indiana and the Pike Township School District in Indianapolis, I was connected to elementary math specialist and master teacher Jane Cooney. Jane and the team

Diagonals can be difficult for some fourth graders (pictured here) to execute but, magically, by fifth grade this is hardly ever an issue.

helped me map out the big picture math concepts linked to my work as an artist. Given that up to this point in my career I had spent most of my time working in veritable isolation as a teaching artist, the support of a math mentor, a school, a school district, and an arts organization was invaluable, and I would not have been able to do this work without them.

In my first meeting with Jane Cooney, the entire structure of what would become Math in Your Feet fell into place. She whisked me into a conference room at her school and said, "Tell me what you do." As I described my small square dance board (more traditionally called a "step-a-tune") and the work I did with kids using Jump Patterns, she immediately started describing the math she saw. By the end of our first meeting, I had more than enough to work with, but I now found myself presented with the overwhelming prospect of having to learn both the math and the corresponding national and state standards that went along with what Jane had laid out. Even more important, I had to figure out how to make it all fit together. Our goal was to retain the integrity of both the dance and the math, and it was up to me to bring the two together seamlessly into the classroom.

Jane suggested creating daily themes drawn from the principles and standards published by the National Council for Teachers of Mathematics. After some experimentation, I established these themes: Patterns ("anything with a unit—a shape, design, rhythm, or motif—that repeats in a predictable and organized manner"<sup>1</sup>), Problem Solving ("engaging in a task for which the solution or method is not known in advance"<sup>2</sup>), Transformation (to change the shape or position of an object), Combination (to find all the different ways something can be combined, such as toppings on a pizza or dance steps), and Communication (to speak fluently about what is learned in both math and dance through written and spoken language, and to express ideas through kinesthetic, rhythmic, and symbolic language). Each theme represents an idea found in both math and dance; each day in the residency we use the math to describe the dance and the dance





Students observing work-in-progress.

to illustrate math concepts, to the mutual benefit of both subject areas.

I introduce the theme of Patterns on the first day of the residency as the foundation of our dancing and creative work, and as the first concept that both math and dance have in common. Problem solving and the creative process are linked and woven into every lesson. Students learn to view themselves as both choreographers and problem solvers as they create their own dance patterns. Through this process, students begin to think mathematically as they choose from movement variables, combine smaller patterns into larger ones, and transform their patterns using different types of symmetry. Communicating their work is another major focus for the students. They reflect daily on their learning through journal prompts and word studies. Using workbooks specifically designed for use in this program,

students identify and record the appropriate terms that describe their dance patterns as well as symmetry and sequencing choices. Math terms are better understood as they are used in context and applied to this real-world activity. Students also communicate their work through mapping using a simple coordinate grid notation system.

Initially, when thinking about how percussive dance might connect to math, I had in mind my own personal notation system for writing down steps and combinations. Just about every clogger/step dancer I know has her or his own special formula; my notation looks somewhat like an algebraic formula. To my knowledge, there is no formal notation system like Labanotation to record traditional percussive dance steps on paper. Since math is essentially a language made up of symbols and abbreviations, I thought there might be



Not congruent, but working on it!

some a connection between how I recorded my dance steps and the use of symbols in math. I also thought that the process of creating personally relevant notation for a concrete, physical experience would be meaningful for the children and make math symbols more accessible. Turns out I was right, but not in the way I originally imagined.

The grid notation system we eventually developed evolved from one of Jane's first observations about my dancing. I dance in the center of my dance board, and encourage students to "find their center" in order to orient their bodies and feet. Jane observed that I was using my board like a simple coordinate grid, consisting of four quadrants with me at the center of the x- and y-axis. I devised a sheet where the students "plot" the positions of their feet on the grid in relation to center, one grid for each beat, and then describe the rest of the step using symbols and a map key.

The grid notation system is still an important tool, but it is not as central to our fundamental work as I first thought it might be. It wasn't until I formalized Jump Patterns, in the process of creating new lessons for the program, that the math connections really started to come together. Jump Patterns were the missing piece that finally brought the dance and math together with a satisfying "click."

## The Dancing Leads the Way

Jump Patterns grew out of the elements of traditional percussive dance. I identified three of the four main categories of percussive dance technique for the students

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***Observers of my work are often curious if this approach has changed my work as a dancer or a choreographer. The answer is no. I have always analyzed my dancing using a visual reference—my dance board, and the images in my head about where I am and where I am going to as I dance.***

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Emily Strawn

The author leading a warm-up.

to use—foot placement, direction, and type of movement. (See chart, page 88.) I purposefully left out the more technical fourth category: use of different parts of the feet. In the past, before these categories were defined, I had given children some experience with clogging steps and Jump Patterns in our group lessons and then, I'm embarrassed to admit, would start their creative work with the exultation, "Just move your feet and see what happens!"

To make these Jump Patterns work for every child, not just the adventurous ones, I first had to formalize the dance space. Years of experience had led me to tape out the perimeter of our class dance space.

Students would file into the room, “put their toes on the blue line,” and away we’d go. The percussive dance I do is precise and, for the most part, can happen in one spot. A clear, visually defined starting spot (the blue line) was invaluable to classroom and time management. After all, a forty-five-minute workshop should not be spent wrangling children into straight lines. The blue low tack painters’ tape did the trick.

I wanted the kids to have a sense of the space I work in, but there was no easy way I could make and transport thirty small, square dance platforms every time I did a residency. So, when planning for our Math in Your Feet residency pilot weeks, I brought out the blue tape again and taped out two-by-two-foot dance spaces, in pairs, for the kids to use during their partner time. This helped the children better orient their dancing in space, especially in clarifying diagonals, and understanding how far they would be turning ( $90^\circ$ ,  $180^\circ$ , etc.). The unintended but very welcome consequence was that now the math they were using while dancing was made visible.

With the students’ dance spaces visually defined and providing a finite space, it becomes very clear if a student’s feet are

in the same position as her partner’s feet, which helps clarify the math concept of congruence (same size, same shape). To further this understanding I ask questions such as, “Are your feet sliding or is that a jump?” “Which direction are you turning in and how far are you going?” and “Do you have your right foot crossed over the left, or is the left foot over the right?” It is also easy to see if the child understands the concept of “center” and if there is a clear understanding of whether they are moving diagonally, forward, backwards, or to the side (actually a great challenge for a fourth grader). Once the concept of congruence is fully understood in relation to the dancing, the students have enough language and visual acuity to apply a transformation and change their patterns using reflection or rotation symmetry.

The defined dance spaces also enable me to make connections to fractions and degrees of turns in both a visual and kinesthetic way. I say to the students, “Face your front. Turn right, to the first side of the square. You’ve turned one of four sides. How far is that using fractions? In degrees?” With a basic rule of no  $360^\circ$  turns in one move/beat, students learn to combine their turns

Students clarifying a choice of direction.



***Once they have this vocabulary, not just for their own moves but for the math that they use to create, sequence and transform their steps, they are able to respond intelligently to other students’ work.***

(e.g.,  $180^\circ$  to the left, then  $90^\circ$  to the right) to make their patterns more interesting and fun. Students consistently remark that their understanding of angles and degrees of turns has improved after participating in Math in Your Feet. Visually defining the dance spaces also makes it possible for me to focus the students' creative work in other ways by defining more precisely what would happen in those spaces. With the movement variables outlined on a chart at the front of the classroom, kids make up steps more easily than before, but even more important, they now have the words to describe what they are doing. Once they have this vocabulary, not just for their own moves but for the math that they use to create, sequence, and transform their steps, they are able to respond intelligently to other students' work. For example, after I have introduced the concept of reflection in class (opposite rights and lefts, everything else the same) the students can challenge and showcase their understanding of this idea by playing the games "Congruent or Reflected?" and "Who's the Reflection?" (Imagine an over-the-top announcer's voice!). As they play "Congruent or Reflected?" they identify if a team's pattern has been danced congruently (moving in the same direction, at the same time, using the same feet and the same movements) and give reasons why or why not, or if the pattern is reflected ("When one of them turned to the right, the other turned to the left"). In "Who's the Reflection?," they observe a team performing their pattern congruently and then reflected. By this time they are experts in analyzing moving patterns and can usually tell which partner changed the pattern. In addition to using math ideas fluently, they also quickly develop a strong understanding and sense of aesthetic in this new dance form and happily give constructive feedback to their peers as we showcase works in progress.

In short, Jump Patterns are the gateway through which students engage in a robust, creative, choreographic process while gaining a fuller understanding of math topics. Formalizing this tool was also the solution for something I had been struggling with for years—enabling students to describe and analyze their own and others' work.






A team of students fully engaged in working out their pattern.

## Nothing Has Changed but Everything Is Stronger

Observers of my work are often curious if this approach has changed my work as a dancer or a choreographer. The answer is no. I have always analyzed my dancing using a visual reference—my dance board, and the images in my head about where I am and where I am going to as I dance. My dance form is rhythm-based, so I also use the musical elements of phrasing, combining rhythmic patterns, and tempo. This is how I thought before creating Math in Your Feet. Finding the relevant math that connects to the work I've always done is a process that has helped me better clarify for children what is going on in the dancing. Percussive dance is by nature precise, and highlighting the relevant math helps kids understand the dance style more fully. I think the integration makes for better dancers and, ultimately, for more interesting creative work.

It does still surprise and thrill me every time kids in a classroom jump up willingly, find partners, and start creating rhythm-based percussive dances. Jump Patterns don't look exactly like clogging or step dance or tap dance. But because Jump Patterns are based on the elements of these styles, kids understand that what they're doing is real. I often make a comparison to the relationship of "creative movement" to other forms of


Movement Variables		
<b>FEET</b> 	Together Crossed Split	Right Left
<b>MOVEMENT</b> 	Jump Slide Step	Hop Turn Touch
<b>DIRECTION</b> 	Forward Diagonal Center	Back Right Left

Included in this chart are three of the four main categories that make up foot-based percussive dance steps. The highly technical category of “parts of the feet” is intentionally left off the chart.

dance like ballet, jazz, or modern dance. Creative movement is not the dance style, but it has all the elements of those styles (space, time, force, body), and as such, it is the perfect vehicle for children to explore and be creative without being tied down (at least initially) to the more technical elements of a particular style. Jump Patterns are to percussive dance as creative movement is to ballet or modern dance. This authenticity paves the way for new understanding of grade-appropriate math topics—real math. And the result can be exhilarating and inspiring.

I’ve also discovered that Math in Your Feet can be successful without a professional dancer present; teachers can learn Jump Patterns and the elements of percussive dance from me and easily transfer that understanding to their students. When I teach my professional development workshops for teachers at Clowes Memorial

Hall of Butler University in Indianapolis, teachers often take my classes for credit. As part of this process, they have to implement an aspect of this program in their own classrooms and then reflect and report on their efforts by writing a paper. The interesting thing I’ve found from reading their papers is that the teachers (who, for the most part, would categorize themselves as “nondancers”) not only have been able to use Jump Patterns successfully but also are able to re-create the same energy, excitement, and learning in their own students without me even being there! I say this proudly because although it is important for kids to interact with a professional artist, it means hundreds, maybe thousands, more kids are getting a chance to make creative choices and understand the relevance of math to something they love to do—move.

Reflection Journal	
Writing is the way we think ourselves into a subject and make it our own. Please communicate your thoughts using full sentences.	
Malke is very interested in your experience with Math in Your Feet. Write her a note and tell what you will remember about this experience 10 years from now:	
Ten years from now I will remember how hard it was to learn and how much fun it was.	
What challenges did you experience this week and what helped you to work through them?	
The challenges I had were putting pattern A and pattern B together. The thing that helped me work through them were because I had Drake as my partner and he was always hard working and an on task friendly boy!!	
I loved this program.	
	
Yours Truly	
Use this blank space to share today's experience any way you want.	
Day Five 29 Communication	

As part of the program, students reflect on their learning in daily reflection journal entries.

## Leave It to the Kids

"I didn't think I could make anything," one fourth-grade boy told me on the last day of the program at his school. By using Jump Patterns, this boy successfully communicated ideas he didn't even know he had. Another child told me, after having spent a week seeing math used in a real-world context, "I don't like math, and I still don't, but I might like it more."

And those fifth-grade girls? On Friday, on the final day of the five-day residency, they and their class celebrated their hard work with a presentation and analysis of fifteen unique pieces of math-informed percussive dance choreography. Due to time constraints, we had not prepared a formal performance, and the presentations were done without music. There was, however, a lot going on. The skill levels of the students varied widely but, for the most part, everyone has exceeded their own expectations of their capabilities. For some, success is slow movement (what I call "beat-by-beat") and clear and accurate

execution of their sequenced eight-count pattern. Other students are fluid dancers who have applied one or more symmetries to their eight-beat patterns and have created choreography where they and their partner switch boxes or are jumping and turning on the diagonal. No matter their physical abilities, most students are able to tell if another team's eight-count pattern is a combination of two different patterns or one pattern repeated twice. They can also tell me what kinds of symmetry have been used to enhance the choreography. They have real answers to the questions I ask them to think about as they watch their peers' work: "What surprised you?" and "I wonder what would happen if ...". And, at the end, although it is not a performance day, I have them dance their patterns to music, half the class dancing and the other half watching, and then switching roles. Not all the kids are ready to sync their dancing with the music, but putting their movement to music clearly illustrates that their creative problem-solving process has led to a real artistic product.

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## Notes

<sup>1</sup>[http://www.brooklynkids.org/patternwizardry/what\\_are\\_patterns.html](http://www.brooklynkids.org/patternwizardry/what_are_patterns.html)

<sup>2</sup>The National Council of Teachers of Mathematics. *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics, 2000. 52.

**Malke Rosenfeld** is an independent teaching artist focusing on math/dance integration, kinesthetic learning methods, and harnessing children's innate love of movement in the search for connection making and creative expression. A Young Audiences of Indiana roster artist, she recently started a blog about her work at <http://www.mathinyourfeet.blogspot.com>.