BOLD VISIONS IN EDUCATIONAL RESEARCH

Transformative STEAM Education for Sustainable Development

International Perspectives and Practices

Elisabeth (Lily) Taylor and
Peter Charles Taylor (Eds.)

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CHAPTER 7

Dancing with Mathematics

An Auto|Ethnographic Study of a Dance Teacher

Neni Mariana and Trisya Maritaria

Abstract

The first author reflects on Trisya's (her graduate student's) research journey as a transformative STEAM learner during which she came to integrate her life-long love of teaching traditional cultural dance with her teaching of mathematics, a subject that she had long hated; the story has a happy ending.

•••

Dance is an expression of emotion and expression through motion. It is part of the performing arts learned by Indonesian students in a subject called *Cultural Arts and Crafts*. It is considered as part of the Indonesian curriculum because through dance students learn cultural values and, as well, it might relate to their other subjects, including mathematics. The idea of combining mathematics and dance is inspired by transformative learning theory applied to Science, Technology, Engineering, Arts and Mathematics (STEAM). However, most people do not think about mathematics while they are dancing, or vice versa. In other words, we barely think that a connection exists between dance and mathematics.

The same thought happened to Trisya, a prospective primary school teacher who teaches dance to primary school children in her spare time. Trisya loves dancing but hates mathematics. Therefore, she was challenged to focus her undergraduate research on exploring creative dance while excavating possible mathematics concepts.

Trisya conducted an *auto|ethnographic inquiry* (Taylor & Luitel, 2019) which focussed on the components of dance creators, dancers, and activities related to *Bungong Jeumpa* which she teaches in a primary school. Bungong Jeumpa is a dance created through a traditional song from Aceh, Indonesia. The dance is created to preserve culture through combining song and traditional dance movements.

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This form of dance is important for promoting cultural sustainability in education, especially at the primary level, in order to pass on culture from our ancestors (Atalan, 2018). According to Bulut and Bars (2013), education can accommodate cultural transmission through generations. Therefore, education can involve a transformative learning journey of *cultural self-knowing* for both students and teachers (Mariana, 2019; Taylor, 2015).

During her journey, Trisya interacted with the creator of the dance, spoke with other dancers, and gave reflective thought to her own dancing and dance teaching experience. She conducted postmodern qualitative *InterViews* with teachers and students about the results of her excavation of cultural lived experience (Brinkman & Kvale, 2015).

In this chapter we portray key aspects of Trisya's transformative learning journey which involved reflecting on the importance of performing arts as an integral part of multidisciplinary learning to make learning mathematics more fun and culturally meaningful.

1 Auto|Ethnographic Background

I couldn't control my desire, what I like and dislike
I hate mathematics but I love dancing
Can I love what I hate?
This is a story of changing feelings

One day a fourth-year graduate student came to my desk and asked me to supervise her research study. She confessed her feelings towards mathematics:

> Mom, please supervise me. I hate mathematics, but I want to challenge myself to take it for my research topic. I love dancing very much, thus I want to combine it in teaching mathematics. However, I am wondering, is there any mathematics in dancing?

Trisya amazed me with her question the first time we met for supervision. I asked her in return, "What do you think?". "I'm not sure, but I usually count 1 to 8 while I'm teaching dancing to my students. Counting 1 to 8, is that the only mathematics in dance?", she wondered.

It is interesting to see how Trisya reflected on her experience, her feelings towards mathematics and her curiosity to begin the study. She used her lived experience as a frame of reference (Mezirow, 1997) to establish her research topic. Since she long had negative feelings towards mathematics, she could

not see a broader connection between dance and mathematics. Bad feelings burdened her pre-knowledge of mathematical concepts in dance. Trisya's difficulty is a typical phenomenon in our education system, as most people barely perceive that there is mathematics in dance or that we can do mathematics while dancing.

Reflecting on my own experience, I had no difference with Trisya's assumption. I was a dancer when I was in primary school. I could not see any relation either between dance and mathematics. My grandfather sent me to learn traditional dance at school. While dancing I barely thought about mathematics. Nevertheless, I heard my dance teacher's instructions, from counting 1 to 8 to the floor pattern and the body movement which should follow a certain angle. In Javanese traditional dance, there is a basic plea called *mendhak* in which the dancer should bend her knee in an acute angle as possible (Rahapsari, 2021). Later in my professional life I became aware of mathematics emerging in other disciplines, such as art.

Since completing my PhD degree I have come across the idea of STEAM, in which mathematics can be integrated with art. STEAM opens opportunity to present mathematics in art, including performing art such as dance. Furthermore, it canstrengthens cultural sustainability if the art is a part of cultural products. To me as an Indonesian math educator, the idea of STEAM is powerful as a means to preserve almost extinct cultures through mathematics lessons. This is in line with Taylor's statement that STEAM education is appropriate for the 21st century education for sustaining cultures (Taylor, 2018). So, since then I have become a mathematics-STEAM educator and am attempting to introduce the idea into my department. Since 2020 the department of elementary teacher education includes STEAM education in our curriculum.

Moreover, since I returned to my department after my PhD life (Mariana, 2017), I have become more open-minded and my student supervisees are getting more diverse. Trisya is one who have come to me with their confessions of hating mathematics; but they do bring talents from other disciplines. The STEAM idea helps me to supervise students with various background and to help change their mindsets about mathematics. At the end of her study, after becoming aware of mathematics in her dance practice Trisya now values mathematics.

A few integrative researchers have attempted to create dance based on mathematical concepts. For example, Belcastro and Schaffer (2011) call this *dancing mathematics* and argue that mathematics is found naturally in the aesthetic body of dance (Watson, 2005). This has led researchers to investigate possible crossovers between mathematics and dance by excavating mathematical concepts emerging during dance (Watson, 1990; Wasilewska, 2012). Researchers

who see this connection have posed ideas about integrating dance and mathematics in teaching (An et al., 2017). However, these studies have focussed only on Western dance.

There are limited numbers of such research in Indonesia. For example, Helsa and Hartono (2011) designed mathematical activities using design research within the context of traditional dance in primary school. Other Indonesian researchers have explored traditional dance movements – *Rapa'i Geleng Dance* from Aceh-Indonesia (Musawwir, Suryadi & Kusnandi, 2021) and *Gandrung Jejer Jaran Dawuk Dance* from Banyuwangi-Indonesia (Hariastuti, Budiarto & Manuharwati, 2021) – in order to find mathematical concepts in traditional dance movement. However, there is no research discussing creative dance and its relation to mathematics in Indonesian primary schools. Therefore, in this chaper we portray Trisya's efforts to excavate primary school math concepts in the creative dance of *Bungong Jeumpa*.

In the context of primary schooling in Indonesia, children learn traditional dance as an extracurricular activity. Although there is a lesson called *Cultural Arts and Crafts*, performing arts covers what we call *creative dance*. Creative dance is created by a choreographer using a traditional song and adopting traditional dance movements. Of course, a primary school teacher can modify the movements, but usually the school has a specific dance teacher to do so. Thus, primary school teachers are rarely able to see the relationship between dance and mathematics, as was Trisya's experience as a primary school dance teacher.

Trisya Maritaria has an interesting ethnographic background. The following story extracted from her research project report provides details of her ethnic background (Mariana & Maritaria, 2019; Maritaria & Mariana, 2019).

A Story about Me

I am a girl with Javanese culture. A girl who lives in a small town called Nganjuk. Call me Trisya. My whole name is coloured by my cultural identity. My first name contains the word *tri* which in Javanese language means three, and my last name contains the word *tari* which means dance in Indonesian language

I live in a family that each member has a talent. My father was a soccer athlete when he was young. No less amazing, my mother is a volleyball and basketball athlete. Meanwhile, my late grandfather was a fan of Javanese performing arts, including traditional dances, *ludruk* (Javanese drama), *campursari* (Javanese casual song), and *wayang* (Javanese puppets). My late grandfather valued Javanese cultures very much. When

there were events such as wayang or dances my father always invited me to watch these events. Therefore, starting from kindergarten I was introduced to and taught several Javanese performing arts.

I was also included in dance lessons from kindergarten. The form of implementing my dance lessons was by participating in dance competitions and performances as an effort to hone my mentality and talent. I am very happy when I get a job to dance, either at school events or outside of school, because for me dancing is a form of expressing an implicit message through beauty.

I am currently pursuing a master degree at Universitas Negeri Surabaya and, at the same time, being an extracurricular dance teacher. Although I have had experience in dance for a long time, I have not forgotten and remain consistent in dancing. I teach and educate others about the knowledge of dance that I have acquired. As part of my job I create dance movements for teaching my students creative dance with traditional songs.

Trisya started to be involved in Javanese art preservation in her early years. It started with the motivation of the family, especially her father and late grandfather, who supported her love of dancing. Dance became her desire and love to spread her talent to others. She became a creative dance choreographer, but now as a primary teacher can she see mathematics through her dance?

2 Discovering Mathematics in Dance

As an Indonesian pre-service primary teacher it is essential for Trisya to have the ability to integrate subjects in her lessons. Since 2014 primary schools in Indonesia have been implementing the 2013 Curriculum in which thematic integration is the main theme. Especially in lower grades of primary school, teachers have to integrate, for instance, art and mathematics. However, as with other primary school teachers, Trisya found it difficult to find the connection. The following story captures her confession about her struggles.

My View on Dance with Mathematics

As a dance teacher, I count each change of motion and when forming a floor pattern. I teach floor patterns to make shape transitions, for example, from circle to horizontal. But my mind says it is just a dance, not mathematics.

> Even during school, the classroom teacher never discusses the relationship between mathematics and dance. How could dance have any mathematical elements? It seems so impossible to me, especially when mathematics has become my mortal enemy since childhood. I am more comfortable dancing for hours than studying math. Just looking at the numbers makes me dizzy.
>
> Actually, I really wanted to overcome my fear with mathematics when I was in primary school. Through my hobby I want to be able to love mathematics. How can I change my mindset towards creepy mathematics? Can my hobby of dancing be able to make me love mathematics? Is there any mathematics in dance? Then what parts of mathematical concepts can I explore from dance?
>
> What is my role as a prospective primary school teacher and as an extracurricular teacher to integrate dance with mathematics? I want to change my mindset about mathematics.
>
> At the end I have a dream to link my love of culture through the field of science so that my students will not experience my negative feelings towards mathematics. Then, how do I change their mindset, including mine?

Based on her confession, Trisya realised that so far the teacher who taught her to dance and her class teacher did not show any mathematical concepts in dance, or vice versa. So when Trisya teaches extracurricular dance she doesn't give an overview of the mathematics in dance. Likewise, when teaching mathematics Trisya also does not connect dance with learning. So it looks like there is a distinct separation of subject areas. However, Trisya's story does refer to mathematics in dance, from counting changes of motion to floor patterns.

I found it very challenging to help Trisya start to see the connection. In order to help her awareness I asked her to focus on an aspect of her past dancing experience and explain the details of dance movements. Trisya remembered one such dance experience. The following story demonstrates the details of her dancing movement experiences during childhood. After writing the piece she reached a conscious understanding of the relationship between mathematics and dance.

> *Dancing in My Childhood*
>
> Kindergarten was the beginning for me to pursue the art of dance. I still remember very well that I participated and was selected to appear at the anniversary of the Brawijaya Regional Military Command in Nganjuk. At

the beginning of the meeting my teacher taught me basic dance movements such as *ndegeg*, *srisig* and *mendhak*.

My teacher counted 1 to 8 for each movement, then repeated it from the beginning. When counting each movement my teacher clapped her hands as a guide for changing the movements and matching the tempo in the dance.

After learning the movements I was taught various kinds of formations (floor patterns). At that time my group consisted of five children. The floor patterns that I remember were forming a circle, horizontal and zigzag lines, and the letter V. In kindergarten I learned some simple floor patterns but when I was in elementary school there were many different floor patterns in the dances I learned. For instance, in the shape of an anchor, in the shape of an arrow, in the form of an alphabet.

At that time my kindergarten dance teacher was very kind and gentle and never asked me to be perfect in what she taught. When I was in elementary school, the way my dance teacher taught me was very different. My teacher often got angry when the body gestures, including movements of the hands, feet, and head, did not match the example. If the position of the teacher's hand is bent 90 degrees, then the position of my hand must also be bent in such a way. If her feet open 3 medium tiles, then yes we should be able to do so.

Especially when I was doing ndegeg, the chest position should be forward, the spine is straight, and the shoulder blades are flat. However, I barely did it perfectly during practice. Therefore, my teacher always gave homework of sleeping with a bolster on my back and asked me to carry a broom stick in the back of my stomach/spine during rehearsal. This was done because, for a dancer, body gestures are very important.

I was also taught during elementary school that dancing requires three important elements, namely, the presence of *wiraga, wirama* and *wirasa*. If the three elements are not applied properly a dance will lose its spirit.

My knowledge of traditional dances across Indonesia began to open up since kindergarten as I learned various kinds of traditional dances. I feel that when I bring a dance from a certain area I am travelling around Indonesia, indirectly and often participating in various kinds of cultural exercises. Dancing has become part of my life.

After sharing this story of learning dance movements, Trisya realised that by describing the details of dance movements she had experienced she could find some mathematical concepts. Counting is the basis of any Javanese dance, with the tempo of 8 taps for each dance movement. Moreover, the floor patterns of

movements and dancers' positions involve geometrical shapes. Javanese dance body gestures are unique. They require certain angles of our body shapes. By telling her story as a dance student Trisya started to understand mathematics through dance.

Furthermore, different roles might bring different insights. If her role as a student helps Trisya understand mathematical concepts involved in dance, what about when she acts as a dance teacher? Does she include mathematical concepts in her instructions?

My Hobby Makes Me a Dance Coach

The experience that I gained in learning to dance I do not forget, even though I am now pursuing my bachelor degree, but not majoring in dance. I decided to take a major that would produce a teacher for elementary school. At first, many regretted my decision, but that did not make me completely disappointed. In fact, the Elementary Teacher Education Department has some courses in the arts, including performance arts. During the 7th semester there was also an interest in dance courses. I am also joining extracurricular dance activities in my department. So, I haven't stopped dancing during college.

My dancing activity during college made my seniors trust me to train their dancing group. It was the first time I had stepped out of my comfort zone and got my first salary as a dance coach. Not only that, I was also entrusted with training dance groups of women from Pertamina. In my heart I am very happy. This can cure my longing for dancing on stage.

Practicing adult dance is certainly not the same as in elementary school. When training adults dance formation movements are more complex, the movements are more detailed and complex, the choice of themes is also unlimited, for example, a couple in love or Indian dance. This is very different from when I trained as a dancer in primary school.

Capitalising on the experience and knowledge I gained between being a student in semesters 7 and 8, I was accepted as an extracurricular dance teacher at two primary schools. Dances in primary school contexts involve childhood experiences, exploring simple movements with themes of play, culture, animals or heros.

The beginning dance that I teach is Bungong Jeumpa. I choose this dance because the students are generally in early grades, so they need a dance with simple movements in accordance with the child's psychomotor abilities. And the Bungong Jeumpa dance philosophy is also suitable because it can be used to introduce Aceh culture to the children.

> Bungong Jeumpa dance is a creative dance that allows me to modify movements for my students. When I start I do not immediately teach children the Bungong Jeumpa dance movements, but first I introduce basic dance movements as basic knowledge for traditional dancing, such as *ndegeg, mendhak, debeg* and *gejuk*. I also introduce facial expressions when dancing. It is only after the students understand these basics that I begin teaching one movement each week.
>
> Starting from the motion of the hands that stretch straight up to the side, legs that bend, and tiptoes, children learn individually to dance by memorising each movement. I form a group to teach them various floor patterns in the dance, such as triangles, hexagons, and horizontal and vertical lines. I create movement with the pattern A B A B. The point of the pattern is that student A has her hands slanted straight up to the right, while student B has her hands slanted straight down to the right. This makes the dance movements even more beautiful.

In recounting this story Trisya realised that she uses basic traditional dance movements influenced by culture in reconstructing creative dance. Some of the movements are inspired by dance that has been studied by researchers, such as ndegeg, mendhak and debeg. Thus, Trisya uses her cultural dance experience to reconstruct dance movements for creative dance. She also considers the abilities of early grade students whilst choosing suitable movements.

Next Trisya decided to analyse the Bungong Jeumpa dance for embedded mathematical concepts. This analysis was conducted by Trisya as part of her research project with guidance and conceptual analysis from me as her research supervisor.

3 Mathematics of Bungong Jeumpa Dance

Bungong Jeumpa is one of the typical dances of the Province of Nanggroe Aceh Darussalam (Istighfary, 2021). In the Acehnese language Bungong Jeumpa means *champaign flower*. The champaign flower represents the strength, pride and charm of the land of Aceh. This dance performance is carried out by combining body movements with an Aceh folk song.[1] In this study, we explored Trisya's students' dance in which the movement is related to the dance movement in the Grade 4 student book. This dance movement is similar to the YouTube video, so we included the video to provide a visual representation of Trisya's explanation.

The Bungong Jeumpa dance consists of two kinds of movements, namely, the upright body position resting on the feet (standing) and placing the body resting on the buttocks (sitting). Bungong Jeumpa dance has its own characteristics and features that can be seen in the movements of the feet and hands, and is not standardised like traditional dance but can be staged only with the accompaniment of the human voice in the form of singing (Yuliastuti, Kurniah & Ardina, 2020).

In the thematic book for fourth grade elementary school students there is material related to the Bungong Jeumpa dance with explanations of the variety of movements, floor patterns and costumes, but there is little discussion relating to mathematics. Based on Trisya's research we describe the results of our exploration of elementary school mathematics concepts in the Bungong Jeumpa dance. In total there are 25 movements of the dance, but for this particular excavation we have chosen three essential aspects of the dance that consist of rich mathematical concepts, namely, the dance rhythm, the movements and floor patterns.

3.1 *Dance Rhythm and Numerical Concepts*

The rhythm in Bungong Jeumpa dance is like most traditional dances in Indonesia which count up to 8 for each movement. The count is adjusted to the changing patterns of motion. Before dancing the dancers are asked to practice using the first count, starting from numbers 1 to 8. If the movement is done two times the count will start from numbers 1 to 8, two times. Thus, repetition is carried out when the movement is, for example, 2×8 for the duration 00.10–00.25 seconds (see Table 7.1). The point of 2×8 is that when the dancer performs a dance move 1 to 8 counting is used as a beat in the dance movement and as a marker for changing movements.

Counting activities are repeated until the dance is memorised. Memorising the counting makes it easier for dancers when accompanied by music. Later, if they already remember the movement, this has an automatic impact enabling dancers to move their bodies without counting. This is because the count is recorded in the student's mind as there is repetition in pronounciation. If we analyse the counting motion based on a certain duration from the video, we come up with Table 7.1. The following table is an explanation of the duration of each movement and the calculations in the Bungong Jeumpa dance.

From this description we can see how students are making sense of number concepts through the dance. When the dancers are dancing they not only move their entire body but also learn and understand the sequence of numbers. Besides, multiplication in the dance appears when repeating the dance

TABLE 7.1 Bungong Jeumpa dance video duration and calculations

No	Duration (seconds)	Counting	Multiplication
1	00.10–00.25	1–8 (2 times)	(2 × 8)
2	00.26–00.44	1–8 (3 times)	(3 × 8)
3	00.45–00.51	1–8 (1 times)	(1 × 8)
4	00.52–01.16	1–8 (4 times)	(4 × 8)
5	01.17–01.44	1–8 (4 times)	(4 × 8)
6	01.45–01.57	1–8 (2 times)	(2 × 8)
7	01.58–02.21	1–8 (4 times)	(4 × 8)
8	02.22–02.33	1–8 (4 times)	(4 × 8)
9	02.34–02.29	1–8 (4 times)	(4 × 8)
10	03.00–03.30	1–8 (4 times)	(4 × 8)

movements. Students are making sense of the sequence of numbers and multiplication through the dance movements for the entire duration of the dance.

The student's mind is synchronising the dance movement and the count – motoric and cognitive actions – so that the brain is equipped to build number sense (Balter, 2001; Martin, 1965). According to Saleh (2009), number sense is sensitivity and dexterity as well as a quick response when counting. The meaning of this understanding is that the person is able to memorise numbers without looking at notes. Sensitivity based on habituation and repetition results in the person automatically doing something without spelling it out. Therefore, in the video the dancer doesn't say the number of each movement and change, but only smiles and focuses on the movements.

3.2 *Patterned Movement and Numerical Concepts*

Figure 7.1 presents one of the patterned movements in Bungong Jeumpa dance – the sitting movement. In this movement students raise hands up and down left to right in a criss-cross pattern. Students are divided into two groups. Group A is a dancer who moves with a bent sitting body position, and then both hands stretch out on the floor to the right and then the left, while group B is a dancer who performs a sitting movement half standing, with the second position in a tilted direction to the right and then left. Group A dancers (sitting half standing) start from the far left, followed by dancers from group B (sitting), followed by dancers from group A, then dancers from group B, and so on.

There appears to be a break from each group, namely, the dancers of groups A, B, A, B, A, B. The two groups have different movements. Counting the dancers

FIGURE 7.1 Patterned movement in Bungong Jeumpa dance

of group A, starting from number 1 (odd), then group B, starting from number 2 (even). If calculated according to the order of the seated dancers, group A consists of odd numbers 1, 3, and 5. While group B consists of even numbers 2, 4 and 6. Then A students move up to half-sitting by raising hands whilst B students move down to sitting by moving hands left and right.

In the dance movement there are both odd and even numbers from the criss-cross movement of the dancers' position. Moreover, there is also a simple direction concept which is left-right and up-down. The half sitting group demonstrates the parallel line concept with their raising hands up movement. From this description of the patterned motion we can conclude that mathematical concepts are emerging during the dance.

3.3 *Floor Patterns and Geometrical Concepts*

Now, we are going to discuss various floor patterns of the dance, as depicted in Figure 7.2. In Bungong Jeumpa dance there is a floor pattern that forms several sets of six points. Each student is represented by a dot on the floor patterns. At the beginning of the dance, students are standing up and forming a line, as shown in Figure 7.2A. Most of the time when they are in the sitting position they form a straight horizontal line. Meanwhile, the standing movements are more varried. The floor patterns of the standing position in Bungong Jeumpa dance form triangles and hexagons. Whilst adjusting to the floor patterns they

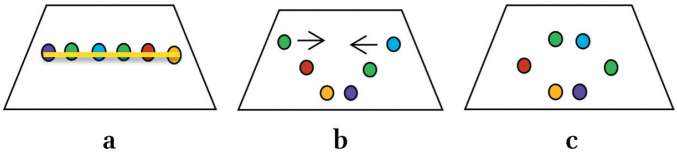

FIGURE 7.2 Various floor patterns in Bungong Jeumpa dance

look at the nearest dancer's position to ensure theirs is correct. For instance, students ensure all the time that they are in a straight line when they are sitting by looking at friends on their left and right hand sides.

From the description of floor patterns we can see that unconsciously students use their understanding of geometrical shapes to create the floor patterns. When they are fitting their positions by comparing to others they learn the properties of a straight line, triangle and hexagon. Of course, the position might not be in exact proportion. Nevertheless, we could argue that the floor patterns increase students' *spatial abilities* in understanding the shapes' properties. Furthermore, they also learn spatially how to shape a straight angle, an acute angle and an obtuse angle whilst adjusting their positions. This observation is consistent with research which demonstrates how students develop *spatial awareness* whilst dancing (Minton, 2003; Temple et al., 2020; Brown & Parsons, 2008; Mainwaring & Krasnow, 2010).

In short, from these observations of students engaged in the Bungong Jeumpa dance we can infer that integrating mathematics and dance performance has the potential to help students build their sense of numerical concepts, geometrical concepts and spatial awaress.

4 How Students Dance with Mathematics

After finding all possible primary school related mathematical concepts through the above excavation, we now describe Trisya's attempts as a dance teacher to integrate the Bungong Jeumpa dance with mathematics.

Okay Kids, Let's Dance with Math!

I am a dance teacher at two primary schools. I implemented an integrated mathematical dance at one of the schools during extracurricular dance. One might wonder, "why was I not teaching mathematical dance in a classroom setting instead?". The main reason is that I wasn't working as a classroom teacher.

From my research, I can understand the problems that exist in my students, namely, their lack of awareness of the relationship between mathematics and dance, and vice versa. Whilst reflecting on my professional role as a dance teacher, I realised that I could make a change, starting with my own students.

When teaching them the Bugong Jeumpa dance steps and movements, I use mathematical terms. This creates a better understanding of the dance floor pattern and the geometrical shapes. Here are some examples:

"Okay kids, we start with the greeting position. We move our two palms together so that the arms form a triangle".

"The next movement should form a conical floor pattern, first like a triangle and then followed by forming a hexagon".

In this way, I use mathematical terminology in my dance instructions to the children in order to help them understand the mathematical concepts of each dance element. After learning to dance I ask the students about the elements of the dance related to mathematics.

"While you were dancing, could you see that you were also learning mathematics at the same time?", I attempt to engage them in a discussion.

"Really?". They seem unbelieving.

"No miss, we were dancing before we studied mathematics", they exclaim confidently.

"Let's try, what do you think about what kind of floor patterns have you formed during the dance?", I help them to reflect.

"Triangle, miss…".

"Straight, miss. A straight line…".

"Exactly. Triangles and lines are included in what mathematics topics, children?", I encourage them to think more.

"Polygon?', they enthusiastically answer.

"Exactly! When we learn polygon, we learn about triangle and a line", I give them more explanation.

"Wow…it turns out that it's more fun to learn math by dancing, miss. I didn't even realise I was studying math", they are amazed.

"Yes…yes…right! It's so cool", other students exclaim.

I help them to reflect on their experience of the dancing exercises. After each student suggests a mathematical concept we discuss it, and I ensure that all students can express their opinions. At the end of the lesson there is usually a firm consensus that mathematics and dance do have a strong relationship.

Trysia's narrative demonstrates two important steps that she takes to integrate dance and mathematics. First, she uses mathematical terminology in her dance instructions. Schaffer (2012) argues that the language a teacher uses in dance instruction helps to develop children's mathematical thinking. Rosenfeld (2011) also used formal mathematical terminology to communicate dance movements. Moreover, mathematical language helps students to develop spatial awareness during the movement, especially geometrical concepts (Temple et al., 2020). Second, the ensuing discussion helps students to identify mathematical concepts by reflecting on their dance excercises and to understand how dance and mathematics are integrated.

The more important issue is that Trisya and her students are transforming. They no longer hold the nightmare perspective of mathematics, and mathematics has become more fun in their eyes.

5 Conclusion

During her study, Trisya found that Bungong Jeumpa dance incorporates mathematical topics such as geometry, measurement, number concepts and operations. This enabled her to re-vision her understanding of education and to perceive a strong connection between separate disciplines within the context of dance that she loves so much. Trisya also came to feel that mathematics is no longer a nightmare because she had found an interesting and culturally meaningful way to teach it.

The findings of this study have been integrated into mathematical learning pratices that can be applied in Indonesian primary schools based on existing basic competencies in the curriculum. We hope that this study inspires primary school teachers in Indonesia to reconsider their interest in the arts as contextual situations for creating culturally based teaching and learning. We urge teachers to conduct a similar process of transformative learning and integrated curriculum study to create interactive and culturally interesting teaching and learning models for educating primary school children.

Furthermore, the study illustrates the importance of integrating the performing arts through dance and mathematics in STEAM education. At the end of the discussion we can clearly see how dance with mathematics can help students to make sense of number concepts and develop their spatial awareness at the same time through the dance movements.

Note

1 The dance video and music can be experienced online here: https://www.youtube.com/watch?v=ZfZxIR9vRmk

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