# FACILITATING CHILDREN'S SPATIAL THINKING THROUGH DANCE

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<u>https://www.youtube.com/watch?v=bdBuDg7mrT8</u>



#### In Today's Workshop:

- Spatial Thinking
  - Its Importance in Early Childhood
- Spatial Language
- Gesture

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- Dance
  - Embodied Thinking
  - Symbolisation



Popular Mathematics Activities



- Spatial skills are not 'teachable', or that there is a lack of knowledge concerning teaching experiences that support children's spatial abilities.
- Understand what spatial thinking is, and what kinds of activities support its developments.

#### Spatial Thinking

"Spatial thinking is integral to everyday life. People, natural objects, human-made objects, and human-made structures exist somewhere in space, and the interaction of people and things must be understood in terms of locations, distance, directions, shapes, and patterns."

(National Research Council, 2006, p. 5)







As a cognitive function, spatial thinking is defined as involving the location and movement of objects and ourselves in space, either mentally or physically.



- knowing where you are and how to get around in the world.
- Understanding relationships between positions in space.





- The ability to understand and perform imaginary movements of 2-D and 3-D objects and spatial forms.
- Thinking with the "mind's eye"
- Generating, inspecting, manipulating and transforming a mental image of objects by moving, matching and combining them.

In the following prism test, can you tell when 1 is folded to form a triangular prism, which of the followings (2-5) can be produced?



The Importance of Spatial Thinking in Early Childhood

Performance on spatial tasks is a significant predictor of success in STEM.

1. Spatial thinking enables any mobile organism to navigate their world to survive and to reflect their physical environment.

2. Spatial thinking is an important predictor of STEM success; it provides a foundation for learning STEM disciplines.

 • 44% of existing jobs in Australia are at risk of automation by digital technologies in the next 20 <... years (PwC, 2015).

Numerical

Quantities

• 75% of the fastest growing professions will require STEM skills.



3. Spatial thinking is an essential human ability that furthers mathematic achievement.

Numeracy

Performanc

Numerical

Concepts

https://www.youtube.com/watch?v=LqV4TlRxZr4

#### Can Spatial Thinking Actually Be Improved?

- "Abilities grow when students, their parents, and their teachers believe that achievement follows consistent hard work and when anxiety about certain areas, such as math, is kept low." (Newcombe, 2010,p.31).
  - It is a skill teachers can develop in learners.
- The development of spatial thinking is enhanced by social learning and teaching practices.

Spatial thinking is moderately malleable and can be enhanced by education and experience.

Rogoff's theory of 'Guided Participation' Children improve their understanding of the world guided by adults or peers.



# The Early Input of Spatial Language

	Dimensional Adjectives	e.g., big, little, tall, short, etc e.g., circle, square, triangle, etc
Spatial Words	Spatial Features	e.g., flat, curved, straight, bent, etc
	Positional Language	e.g., above, below, opposite, near, etc
	Directional Language	e.g., left, right, north, south, etc

# The Early Input of Spatial Language

- Exposure to spatial language can augment one's ability to think about the spatial world (Pruden et al., 2011).
- Children who hear spatial language while performing spatial tasks do better on tasks than those who hear non-spatial terms.

Related Spatial Language:

"I'm putting the winner on/in/ under the box', or 'I'm putting the winner at the top of/at the middle of/at the bottom of the box" (Lowenstein & Gentner, 2005, p. 323).

• Children's use of spatial words is a predictor of their success in performing a spatial task.

# Spatial Talk

Does exposure to rich spatial language from an early age in a natural environment, without any expectation to perform spatial tasks, improve children's spatial thinking in later life?

- Early spatial language input can have a positive impact on children's spatial thinking (Pruden et al., 2011).
- Children's spatial language production is a significant predictor of their later spatial skills.



1:17



#### Gesture and Spatial Thinking



Idea units are expressed in gestures and speech together, with gestures expressing the imagistic aspect (McNeill, 1992). Spatial thinking is integral to gesture production, because mental images typically incorporate spatial information, and such images underlie gesture production (Alibali, 2005).

# Gesture and Spatial Thinking

- The more children gestured about moving the pieces when asked to explain how they solved the task, the better they performed (Ehrlich et al., 2006).
- The positive role of iconic and deictic gestures on the child's spatial understanding and communication (Elia, Gagatsis & Heuvel-Pahnuizen, 2014).

Pointing movement to existing or virtual objects and actions in space





Visually representing attributes or actions related to objects or events.

• Children who hear spatial language with gesture will produce more spatial talk, and do better at spatial tasks (Cartmill, Pruden & Golden-Meadow, 2010).



# The Significance of Gesture in Children's Spatial Thinking

• Both watching someone else's gestures and producing one's own gesture can improve children's learning (Ehrlich et al., 2006).

 Gestures teachers produce during instruction facilitates children's learning by assisting them to understand the words that accompany the gestures (Cook & Golden-Meadow, 2006).



• The strong contribution of purposeful inclusion of gesture plays a key role in children's spatial learning.

#### Gesture in Dance

• A communicative tool employed by dance (Hanna, 2015).

• A vehicle of symbolisation



• Understanding and communication the different meanings of concepts.

• Gesture is celebrated as the foundation of expressive activity in dance which empowers the dancer to express itself.

Learning experiences which included movement and, specifically dance-type activities, motivated children to be more engaged with learning spatial skills.

#### Dance

Spatial Thinking

Gesture

Spatial Language

## Dance in Education

• Dance is one of the hundreds of languages of children who experience a spatially-oriented and body-focused way of thinking (Edwards, Gandini & Foreman, 2014).

- Exploring what their body can do.
- Observing how their body feels in the space they occupy.
- Discovering how to move through space.



• Communicating thoughts, feelings and ideas by using naturally created bodily movements.

## **Embodied** Thinking

- A principle function that supports children's learning through dance.
- 'Thinking in movement'
- Thinking that is influenced by the physiological processes that are involved in perception (Anderson, 2003).



- Individual action responses are used to shape the interpretation of the information taken in (Deans, 2016).
- Expressing and communicating thoughts through the bodily movements in dance.

# The Embodiment of Learning

• Children's bodily movement, known as cognitive action, plays an integral role in knowing, thinking and learning mathematical concepts.

• 'Sensuous Cognition' (Radford, 2009).

• The body is a point of reference and a source of experiences to think, learn, and develop.



Source: Deans and Cohrssen (2015)

• Within gesture and dance, the body can play a significant role in interpreting and expressing spatial concepts and learning.



Dance, as a form of embodied cognition, which involves body thinking and learning, has the potential to provide our learners with opportunities to explore their spatial environment and to develop spatial understanding through their personal and general

space.

# Symbolisation

• Children's experience of dance associates movement with symbolic action and meaning that stimulates cognitive symbol-making capabilities in the brain.

• Words, as abstract symbols, can embody meaning through concrete experiences of what they represent.



# BRAIN DANCE

By Ann Gilbert

Series of basic body movement patterns that helps us organise our brain and our body.

https://www.youtube.com/watch?v=JRMOMjCoR58



# SYMMETRY DANCE

Symmetry is a powerful tool in the science of dance and the art of mathematics (Stern & Schaffer, 2012).

https://www.youtube.com/watch?v=ug8hCAyBaqg



# **Dance and Mathematics**

• Embodying the problem is memorable. It is social, it is creative and it makes the mathematical ideas accessible (Shaffer & Stern, 2012).

• Collaborative Learning



- Children's mathematical thinking may be developed in socially interactive situations where interactions with each other emerge through bodily orientation, gesture and speech.
- Physical energy in the classroom, far from being a distraction, can be an opportunity for all ages and all disciplines.

# **Implications for Early Childhood Teachers**

• Dance, as an influential ally in learning and education, can play a key role in supporting the development of spatial thinking in young children and subsequently building strong foundations of learning STEM based concepts.



• Design creative movements accompanied by very simple rhythmic patterns, related gestures and spatial language.



# THANK YOU

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