Use of Mathematics in Deuda Naach: Logic and Geometry

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Abstract

The major concern of this article is to explorethe use of mathematics on Deuda Dance in Karnali State and it can beuse in teaching learning process in mathematics class. Specifically, Deuda Dance is improve students' math skills, critical thinking, logical skills and creativity, as well as enhance student motivation, socio-emotional and motor skills. The pleasant nature of the activities is also highlighted, an element that is believed to make this method adequate for students of low achievement in math. Deuda players make different geometrical shapes according to the different rhythm of Deuda songs. The body movement and the steps of the foots of kheladi (players/dancer) are more interesting and meaningful for geometry teaching, on the other hand, singing songs at the time of Deuda dance also interesting and mathematical logics are used in songs.

Key words: Body movement, geometrical shapes, rhythm, synchronized, kinesthetic

Introduction

The connection between math and arts has always been present. Math and art seem to have a long historical relationship since the ancient times; ancient Greeks and Egyptians knew about the golden ratio and incorporated it into the design of monuments such as the Great Pyramid and the Parthenon, while painters, such as Leonardo Da Vinci and Mc Escher used mathematical forms in their work. The interdependence of math and arts is further demonstrated in the use of mathematical elements of time, tempo and measure in music or in the counting of beats in choreographing movement.

Dienes (1973, 2004) presented an approach on how mathematical structures can be effectively taught from the early grades onwards using games, manipulative, stories and dance in order to understand mathematical concepts. Tytherleigh & Watson (1987) explored how dance has been introduced to students to support the learning of curricular mathematics. Similarly, Watson (2005) suggested the use of kinesthetic experiences associated with dance in teaching to promote engagement

and learning in spatial, rhythmic, structural and symbolic aspects of mathematics. Moreover, the choreographer Laban created an educational form of dance using interweaved icosahedra to represent directions and qualities of movement and provided a framework of actions which can be used as a basis for the creation of dances inside the classroom (Laban & Lawrence, 1974; Watson, 2005).

For centuries dance has been regarded as an aesthetic experience, an entertaining work of art, and a vehicle for gratification. History also demonstrates that dance has been utilized in other areas such as psychology, counseling, and medicine (Chodorow, 2013; Bracilovic, 2009; Meekums, 2015). For example, dance has been used in treating depression, teaching languages and mathematics.This clearly demonstrates that dance has utilitarian purpose because, in addition to its aesthetic appeal, it has established therapeutic, cognitive and instructional benefits. It is established that "Incorporating music, art, role-playing and games into the curriculum" made the lessons engaging to learners (Cook, et al, 2013; Taylor, 1981, 22). The systematic body movement through dancing is used to support learning. Integration of math and dance may be cognitively beneficial to children who are familiar with math and dance concepts because "cognition is the emergent outcome of dynamic and adaptive sensorimotor interactions with the social and physical environment" (Semin and Smith, 2013, 125).

Westreich (2002) recommends dance to teach math because dance is an engaging modality and it may help students visualize a problem. In addition, dance may be an appealing vehicle to help visual and kinesthetic learners to understand the basic geometric shapes such as square, rectangle, triangle, and diamond.

Dance can be used to teach the fundamentals of mathematics and provide the students with basic intuition about the abstract concepts involved. Applying mathematics to more familiar 'real life' situations would certainly remove the stigma of the field being dry and inaccessible. The math concepts can be used consciously to create dance. Many choreographers create pieces based on their intuition; being explicitly aware of the principles they are applying could help speed up the creative process. Taking the idea further, some might decide to structure the whole piece in terms of count and formation progressions, then within those constraints decide upon actions of individual dancers.

Deuda Naach

Deuda is the most popular dance and song form of Karnali and Far-western state of Nepal. It is a way of celebrating a festival, making merry young boys and girls courting. Arm in arm, men and women sing and dance, on and on. The songs sometimes are questions and answers, known commonly as a Deuda. Deuda song include Thadi Bhakha, Rateri, Hudkeuli. That is the style of stepping (one step forward half-step backward), the forms of Deuda vary from district to district, from village to village. Deuda songs are not generally accompanied by drums, flutes or other musical instruments. Deuda has its origin from the earliest times. The rhythm of Deuda remind a scholar of Vedic hymns. As a Rigvedic or Yajurvedic hymn is recited, Deuda songs are sung slowly, leisurely (ICH, 2007)

There is no rules as to who and who may participate in Deuda, who can sing Deuda song and play DeudaNaach, can participate at one group. It is performed by group of male and female or male and male or female and female. Number of male and female are gathered together, make a circular chain of players and start singing Deuda dance. Through this dance people also express their feelings, sorrow and happiness to each other which helps them to be released from their grief. (Deudasamaaj.com. Retrieved, 2014).

Literature Review

There is copious research on the topic of integration of mathematics and dance (Brillon, 2014; and Rosenfeld, 2013), but there were no studies that looked at teaching geometry utilizing *Deuda Naach*. Research has shown that dance can be integrated in teaching math while teachers explore "a meaningful way to encourage students to consider alternatives to traditional teaching" (Cook et al., 2013, 598). Also, new approaches to problems of teaching number theory through embodied movement and dance is sought after (Dale, 1946, 1996; Devichi and Munier, 2013). In addition, Rosenfeld (2013, 211) claims that dance facilitates math learning including concepts such as, "congruence, symmetry, transformation, angles and degrees, attributes, pattern recognition, symbols, and mapping on a coordinate grid."

Zuckerbros (2011) describes a 6th grade teacher's approach to guiding her students to choreograph a dance. Through her strategy, the teacher encouraged her students to learn elements of geometry and write the directions to recreate the dance. Rosenfeld (2013), a trained percussive dancer, uses dance to teach her elementary students to learn to create different shapes.

She helps her students understand how math is not just figurative depiction, but a thought process. Rosenfeld teaches her students to take responsibility while learning by creating an environment where students can experiment and later discover the shapes by themselves instead of depending on the teacher to dictate to them (Jiesamfoek, 2012; Tomlinson, 2011).

According to McCarthy-Brown (2014, 128), "dance is an expression of culture and through dance, cultural traditions are preserved, lived, shared, and explored." Along with cultural preservation, it is also established that dance can be utilized to teach math; however, there is no specific study on *Deuda Naach* and math. This mixed methods study examines the students' understanding of learning the basic geometric shapes using *Deuda Naach*.

Research Question/ Objectives

The overall aim of this study is to become better acquainted the use of mathematics in Deuda Naach, which incorporates dance, songs and movement in the teaching and learning of maths. More specifically, the objectives of the study are related to the exploration of the impact of Deuda dance on students' different domains. Consequently, the main research question are formed as follows:

1.	What mathematical domains are used in Deuda naach?

2.	What types of mathematical logics are used in Deuda songs?

3.	How can use deuda Naach in teaching learning process in mathematics class?

Theoretical framework

This study draws from social constructivism. Social constructivism

theorists "believe that much can be learned from investigating an individual's sense-making strategies as he or she attempts to understand mathematical ideas" (Steedman, 2000; Shoval, 2011; Young and Collin, 2004). The concept of integrating knowledge from one domain into another can be applied to dance learning because like math, dance utilizes the same concepts of sense making and comprehension of ideas (Brillon, 2014; Steedman, 2000; Westreich 2012). The learner builds knowledge based on her understanding of the world and the interaction with the materials presented.

Teaching geometric shapes through dance may enable students to grasp the skill set quickly as compared to teaching using the traditional methods of lecturing and through board work (Jensen, 2000).

Multiple intelligences accommodate students with different learning styles in our classrooms. Gardner identifies seven different kinds of learning styles and I am focusing on the four styles applicable for this study. *Deuda* players can be visual, spatial/kinesthetic, auditory, and logical/mathematical. Visual learners expect pictorial aids and other illustrations to help them learn. Spatial/kinesthetic learners understand the lesson if taught using bodily movement and heuristic learning activities. Auditory learners seek out aural instructions and logical/mathematical learners may look for information presented in a calculating and analytical fashion (Gardner 1999). *deuda players* uses all of these intelligences through movements (exit, entry, poses, and positioning on stage while dancing), music (tonal semiotics), and formations (simulation and coordination including stage movements).

Like Rousseau, Montessori, and Piaget, Dewey believed that the physical environment played an important role in children's learning and he defined experience as the interaction between an individual and his/her environment (Dewey, 1938). Considering Dewey's pedagogy by engaging students in experiential learning activities, knowledge acquisition and skills development can be promoted through auditory, kinesthetic and visual modalities. In this way, students establish new schemes associated with the teaching and learning process. In Piagetian terms, this new scheme is open to assimilate previously unfamiliar knowledge and skills and construct new knowledge. The process of the experiences engaging auditory, kinesthetic and visual capabilities to construct this new scheme is called learning (Brooks and Brooks, 1993).

Methodology

The design of this study is qualitative in nature. A qualitative research is multi-method in fullness involving an interpretative naturalistic approach to its subject matter. It is based on verbal description. Qualitative research is a form of inquiry that explores phenomena in their natural setting and uses multi-methods to interpret, understanding, explain and bring meaning to them. Qualitative research means any type of research that produces findings not arrived at by statistical procedures or other means of quantification. It can refer to research about person'slife, experiences, behaviors, emotions and feelings as well as about organizational functioning, social movements, cultural phenomena and interactions between nations.It is a non-mathematical analytical procedure. The basic meaning of gathering data are observation and interview including the field notes, documents, books, tape

records, diaries and so on (Strauss and Corbin, 1990).

The collected information analytically interpret by using holistic perspectives. The main objective of the qualitative research is to analyze and interpret the situation, phenomenon, problem and event in accordance to personal contact and insight of researcher. Therefore this research was conducted on the basis of qualitative research. The objective of this study is to explore the use of mathematics in DeudaNaach and it can be used as a teaching method in mathematic class. The information and sources needed for the study were based on primary and secondary sources of data. Primary data was collected from field survey, face to face interview with respondents, participating observation, photographs and video record. Similarly, secondary data was collected from different journals, books and related published and unpublished documents.

Data Collection Procedure and Limitation

Qualitative researches use the information from the people about their experiences, ideas and beliefs. The researcher in this study adopted participant observation, face to face interview and photographs to get primary data. But the researcher had collected secondary data from different articles, journals, books and other published and unpublished documents.

This study is limited in Karnali State. All the data and information are taken through Deuda Kheladi. Surkhet is the head quarter of Karnali State. Khulla Manch in Surkhet, Deuda Naach is held 1st and 15th of each month. All the Deuda players of Karnali State are gathered there and start Deuda

Naach. So researcher is concentrate to Surkhet.

Findings

Geometry is perhaps the most apparent subfield of mathematics present in dance. We can consider the shapes, patterns, angles and symmetry of many different aspects of dance within a variety of scopes. Dancers use symmetry and geometry to improve their performances and make them visually appealing. We enjoy looking at symmetrical things because our brains like to hunt for patterns. We like regular geometrical shapes for the same reason, and these often form the basis for dance. So when a dancer lifts their arms together or traces out a square as they move, they're making use of math to create a better dance.

Researcher participant Deuda Naach in several times and taking individual interview with selected Deuda players, following information are obtained.

Deuda singer Ram Bahadur Budha (Jumla) said that, in previous days, Deuda dance played only for entertainment between youth (Theta-Theti, Chhotta-Chhotti). Youth went secluded place from village and played Deuda dance. Nowadays, Deuda dance playing for multi-purpose, not only for entertainment. It used for social awareness, entertainment, tourism, politics etc.

Deuda singer Laxman Singh (Kalikot) said that, Deuda can play in a huge group of peoples. The body movement and the steps of the foots of kheladi (players/dancer) are more interesting and meaningful for geometry, on the other hand, singing songs at the time of Deuda dance also interesting and mathematical logics are used in songs. Not only use mathematical logic, they sing different fields of songs at the time of

Deuda dance. Sometime they use politics, mathematics, religious, love, social awareness, education etc. There is a circular chain of players and they take their one or two footsteps. Men and women both get joined in this dance and they started singing simultaneously, that is also called "Juhari" on their own word.

- There are a lot of similarities in every dance. They all use angles, geometric shapes, line segments, parallels, right angles etc.

- In Deuda dance, there makes geometrical shapes with players (dancers) body, such as circle, curve, triangle, semicircle etc.

- There are five elements of Deuda dance. They are mathematical logic, space, time, movement and energy.

- Players make different geometrical shapes according to the different rhythm of Deuda songs.

- The players make different angles and geometrical shapes with their legs, foots, hands and other body movement.

- In Deuda, players must constantly be counting their steps in order to keep time with the music and rhythm. If anyone miss a beat, he will no longer be synchronized with the other players.

Fig. 1: *Some photos of DeudaNaach, playing Deuda in different rhythm of song*
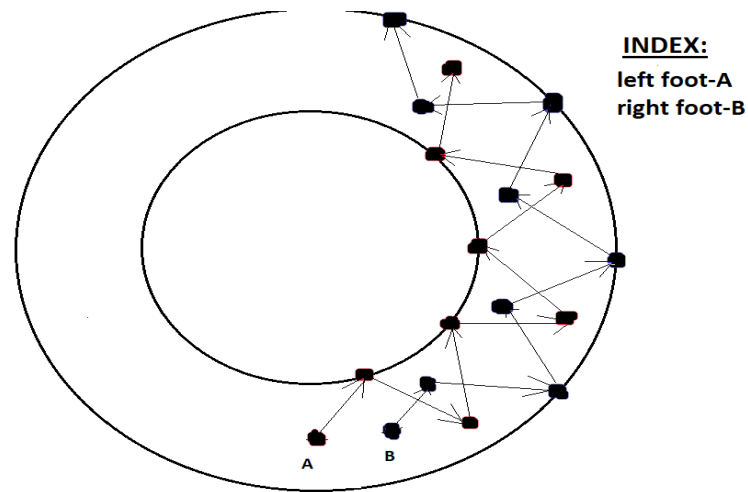
Fig. 2: *Diagrammatic representation of footsteps of DeudaNaach*

Deuda singers Laxman Singh (Kalikot), Purna Prasad Dhital (Jumla), Hari Bahadur Rokaya (Mugu) and Lalit Thapa (Dailekh) said some Deuda songs as:

Chha chha barha chha athara, chha thapyo chubisa

Taa bhayau gharbari baaja, kya maanaula tisa

(Six six twelve and six eighteen again add six twenty four

You are already married what you love me)

Paanch pandab saya bhaai kaurab Krishna kata tira

Ko hunaan kaska hun chhora Karan jasta bira

(Five Panndav and hundred Kaurav, whose side be Krishna?

Who and whose son vir Karan?)

Tin bhuja tinai chhan kona sabai kona saathi

Janne le puraskaar paaune na janne le laathi

(Three sides, three angles and each angle sixty degree

Who know get award and don't know get stick)

Dui dunaa chaar, chaar dunaa aath, aath dunaa sola bhai

Tin junalaai sola syau paanch padi yak shesh rahi

(Two twoja four, four two ja eight and eight two ja sixteen

Sixteen apples divided by three persons, each gets five and remaining one)

Paanch saya bhedaako bagaal dui juna gwalaa

Din raata baleko balei dailekh jwalaa

(Five hundred flocks of sheep, two shepherds

Always burning flames of fire in Dailekh)

Conclusion

On the final note, we can say mathematics is present in dance. It is not the mathematics of simple number manipulation; not an attempt to add or integrate through movement, instead to employ abstract mathematics and various methods of analysis to understand dance at a deeper level. There are superficial links such as counting steps or noticing shapes and also deeper connections, such as mathematical concepts arising in dance, mathematics inspiring dance, or using dance to solve choreographic problems.

It is well known that every dance is related with mathematics. Without mathematics no any dance is possible to conduct. deuda Naach is a cultural Naach of western Nepalese people. in Deuda Naach, we can observe maximum use of geometric shapes as circle, curve, triangle, semicircle etc. through the players footsteps, legs, hands and other body movements. On the other hand, the mathematical statements (logic) are also used through Deuda songs. Players can question and answer of mathematics through Deuda songs.

We (mathematics teachers) are tired of teaching mathematics in traditional methods in school level because students are not getting it interesting what we actually want to give them. So their passion towards mathematics is degrading and overall base of mathematics is weakening day by day. Therefore, it will be a better teaching learning method to teach mathematics through Deuda Naach in Karnali State which will be more practicable and entertaining. However, it may not be fit to the students of other places due to the lack of knowledge about Deuda Naach.

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