

# Use of Mathematics in Deuda Naach: Logic and Geometry

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**Abstract:-** The geometric shapes seen in the body movements in the very popular Deuda Naach (Naach means dance in Nepali language) of the Karnali region of Nepal and the arguments used in the Deuda song show the experimental, logical, and creativity of mathematics. The major concern of this article is to explore the use of mathematics on Deuda Naach in the Karnali region and it can be used in the teaching-learning process in mathematics class. A qualitative research design was used to collect the information and interpret it. Specifically, Deuda Naach improves the mathematics skills, logical skills, creativity, and critical thinking of students. Also, it enhances the motor skills, socio-emotional level, and motivation of students. Deuda players (players refer to the dancers dancing in Deuda songs) make different geometrical shapes according to the different rhythms 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 Deuda songs along with Deuda Naach makes it more interesting and mathematically logical as mathematical and geometrical references are used in songs.

**Keywords:-** Body movement, geometrical shapes, rhythm, synchronized, kinesthetic

## I. INTRODUCTION

The inter-relationship between math and arts was prevailing from the historical time in different civilizations. History is evident to prove math and arts having a collateral historical relationship since ancient times (Shaffer & Stern, 2010). In some instances, ancient Greeks and Egyptians knew about the golden ratio which they applied into the design of famous monuments like the Great Pyramid and the Parthenon. Leonardo Da Vinci and Mc Escher; world famous painters used mathematical techniques and notions to complete their work. Similarly, dance and music also were never far from the mathematical dependency (Watson, 2005). Dance and music widely demonstrate the interdependency of math and arts by using the mathematical elements of time, tempo, and measure in music and in the counting of beats in choreographic movements of dance (Westreich, 2000).

Dienes (1973, 2004) presented an approach on effective teaching of mathematical structures from the early grades using games, manipulative stories and dance in order to understand mathematical concepts. He also explored the use of dance among students in order to support the learning of curricular mathematics. Similarly, Watson (2005) suggested the use of kinesthetic experiences incorporated

along with the dance in teaching to promote engagement and learning in spatial, rhythmic, structural and symbolic aspects of mathematics. Any dance enhances students' intimacy with mathematical subjects and arouses interest in mathematics and ultimately, real mathematics is learned. Dance has been considered as an aesthetic experience and practice for centuries. It has been an entertaining work of art which has been transporting the gratitude and knowledge from the generation to generation. History says dance covers a wide application areas and scopes by demonstrating applicability in areas such as psychology, counseling, and medicine (Chodorow, 2013). For instance, dance has been used in treating depression, teaching languages and mathematics, enhancing physical well-being and sound health. This transparently shows that dance has multiple purposes and utilities because in addition to its aesthetic appeal, it has established therapeutic, cognitive and instructional benefits for the people and society. These facts established that "Incorporating music, art, role-playing and games into the curriculum" help in making the lessons engaging to learners (Cook, et al, 2013). Following the essence of the learning through the systematic body movement i.e. dancing, it can be claimed that the integration of math and dance might 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 & Smith, 2013, 125).

Westreich (2000) also recommends dance to teach math because dance is an engaging modality. It may help students to visualize a problem. In addition to this, dance can be an attractive medium to help visual and kinesthetic learners from where they can be able to understand the basic geometric shapes such as squares, rectangles, triangles etc. That means any dance can be used to teach basic knowledge of abstract concepts of mathematics and students would be learn mathematical concepts using their intuition along with dance. The use of dance and mathematics to more familiar and real life situations would be more effective which would certainly remove the stigma of the field and preserve it from being dry and inaccessible (Devichi & Munier, 2013). Conversely, the mathematical concepts can be used consciously to create dance as well. Many choreographers usually create pieces based on their intuition and experiences. They are very aware of the principles they are applying and things that could help to speed up the creative process. However, some of them might decide to structure the whole piece in terms of count and formation progressions which are the basics of mathematics and decide the whole choreography set within those constraints. That's how dance and math had been inter-relating and

interdependent with one another and further can be carried out in the teaching of mathematics by creating the state of impression and expression.

## II. DEUDA NAACH

Deuda songs and Deuda dances are very popular in the Karnali and Far Western regions of western Nepal. Deuda dances and songs are danced and sang at local festivals and formal and informal events. Deuda dance is used to exchange happiness or to express one's thoughts and feelings to others (KPPC, 2019). In Deuda dance, male-male, female-female or male-female of any age, are asked questions on different topics in the form of Deuda song. The Deuda dance, which is played with the movement of the footsteps and the flexibility of the hips in a circular form by joining hands to hands, is a logical debate throughout the song (Acharya & Paudel, 2020). According to local Deuda players, Deuda dance involves physical exercise as well as enhancing logical powers because the answer to the question asked by the other side has to be answered immediately through Deuda song which develops creativity.

There are no rules as to who and who may participate in Deuda, who can sing Deuda song and play Deuda Naach, can participate at one group. It is performed by group of male and female or male and male or female and female (Acharya & Paudel, 2020). Number of male and female are gathered together, make a circular chain of players and start singing Deuda dance. Through this Deuda dance, people also express their feelings, sorrow and happiness to each other which helps them to be released from their grief (KPPC, 2019).

## III. RESEARCH QUESTION/ OBJECTIVES

The overall objective of this study is to explore the mathematical concepts used in Deuda Naach, which includes and practices dance, songs, and body movement. 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 is formed as follows:

- What mathematical domains are used in Deuda Naach?
- What types of mathematical logics are used in Deuda songs?
- How to use Deuda Naach in teaching-learning process in mathematics class?

## IV. LITERATURE REVIEW

There is a deep relation between dance and mathematics. Every steps of each dance is related to mathematics (Brillon, 2014; Rosenfeld, 2013). But there were no studies that looked at teaching geometry utilizing *Deuda Naach*. Different research has shown that every dance can be integrated in teaching mathematics in the classroom while teachers explore "a meaningful way to encourage students to consider alternatives to traditional teaching" (Cook et al., 2013, 598). Also, the new approaches to teach the problems number theory by using dance with body movement is more suitable (Dale, 1946). In addition, Rosenfeld (2013, 211) claims that every dance facilitates

math learning including mathematical concepts such as, "congruence, symmetry, transformation, angles and degrees, attributes, pattern recognition, symbols, and mapping on a coordinate grid."

Zuckerbros (2011) describes the teacher should encourage the students to learn concepts of geometry, geometrical configuration, and direction to recreate the dance. Similarly, Rosenfeld (2013) uses dance to teach her school students to learn different types of geometrical shapes and configurations. She helps her students to understand how math is not just a figurative depiction, but it is a thought process. On the other hand, by creating an environment for students to dance and make them dance, they will create more ideas of different geometric shapes and figures while they are dancing (Jiesamfoek, 2012).

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. To establish a relationship between one domain to another domain, dance plays an important role in creating practical knowledge as well as developing mathematical ideas and making clear mathematical concepts (Brillon, 2014; Steedman, 2000). They claimed that the learner builds new knowledge based on his/her understanding of the object or world and the interaction with the materials presented. Teaching geometric shapes through different types of dance is more effective for students to grasp the skill set quickly as compared to teaching traditional methods of lecturing and through chalk dusters work (Jensen, 2000).

## V. THEORETICAL FRAMEWORK

The study is based primarily on Gardner's theory of multiple intelligence. Similarly, Vygotsky's social constructivism has also taken equally importance. In constructivism, teachers and students stand as a meaning maker who gives contextually based meaning to each other's words and actions as they interact (Cresswell & Cresswell, 2018). Learning is directly associated to our connection with other people. Our Cultures, our communities, our families, our peers, and our acquaintances impact our learning. Every Knowledge is socially constructed and children learn when they get a contact with the outer environment either verbally or observantly. Vygotsky's theory is one of them that regards social interaction between peers and adults as an important aspect in creating meaning-making sense and conveying culture within the shared context (Vygotsky, 1997). According to social constructivist Vygotsky, knowledge is constructed in two ways in the social context. Firstly, social interactions influence the nature of knowledge that is constructed and the process of individual users to construct that knowledge (Watson, 2001). Thus the constructions are socially centered in value, process of understanding, constructing meaning, and making sense. The children's construction of knowledge is not from only individuals but

also the content, the context, and the interaction with more others.

Gardner defines intelligence as a “bio psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture” (Gardner, 2000, p.28). He identifies eight different kinds of intelligence however the researcher in this research focuses only on three types of intelligence. Every human being has different kinds of intelligence (Gardner, 2010). According to Gardner, bodily-kinesthetic intelligence, logical-mathematical intelligence, and musical intelligence are important intelligence. The body movements of the students, the music of the songs, and the logical questions and answers in the songs work to enhance the effective learning of the learners (Stanford, 2003).

## VI. METHODOLOGY

To explore the mathematical concepts which are used in Deuda Naach, researcher adopted a qualitative research process. Qualitative research is an inquiry process that explores and seeks to understand a social or human problem (Creswell & Creswell, 2018). Also, they focused that qualitative methods are the methods concerned with the completely naturalistic interpretation of phenomena in terms of people’s experiences. Likewise, Frankel and Wallen (2003) stated that qualitative research provides an understanding of the entire situation or phenomenon that tells the story rather than determining cause and effect.

My choice of the qualitative inquiry process will also be based on the fact that it will be informed and guided by the constructivist paradigm, which will be the theoretical framework of the study. The constructive paradigm holds that meanings and knowledge are socially constructed by individuals involved in the research situation (Creswell & Poth, 2018). The meanings are varied and multiple and are negotiated socially and culturally as individuals interact with each other in society (Aminesh & Asl, 2015). The basic meaning of gathering data are observation and interview including the field notes, documents, books, tape records, diaries and so on.

The collected information analytically interpreted 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 Deuda Naach 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.

## VII. 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. In Khulla Manch, Surkhet, Deuda Naach is held 1<sup>st</sup> and 15<sup>th</sup> of each month in terms of Nepali calendar. All the Deuda players of Karnali State gathered there and start Deuda Naach. So researcher is concentrated to Surkhet.

## VIII. FINDINGS

Different shapes and configurations of geometry are associated with the body movement of the Deuda dance. The movement of the legs, the position of the hands, and the flexibility of the hips give a clear concept of different shapes of geometry in the school level. The researcher himself has been directly involved in the Deuda dance, which is held on the open stage of Surkhet on the 1<sup>st</sup> and 15<sup>th</sup> of each month, and in the various festivals and cultural programs of Jumla, Kalikot, Dailekh, Mugu, Humla and Dolpa. The body movements of the Deuda players participating in the Deuda dance and the logic of the songs they sing seem to have ample mathematical concepts. The researcher participates in Deuda Naach several times and took individual interviews with selected Deuda players from where following information are obtained.

Deuda singer Ram Bahadur Budha (Jumla) said “*in past days, Deuda dance was played only for entertainment between youth (Theta-Theti, Chhotta-Chhotti). Youth went at secluded place from village and play Deuda dance there. Nowadays, Deuda dance has been playing for multi-purpose, not only for entertainment. It is used for social awareness, entertainment, tourism, politics etc.*”

Deuda singer Pusparaj Shahi (Kalikot) said “*Deuda can be played in a huge group of people. 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 makes it more interesting and mathematical logics are also used in songs. Not only the use of mathematical logic, they also sing songs from different fields at the time of Deuda dance such as 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, they make geometrical shapes with co-players' (co-dancers') body, such as circles, curves, triangles, semicircles 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, feet, hands and other body movements.
- In Deuda, players must be counting their steps constantly in order to keep time with the music and rhythm. If anyone miss a beat, he/she will no longer be able to be synchronized with the other players.



Fig. 1: Some photos of DeudaNaach, playing Deuda in different rhythm of song

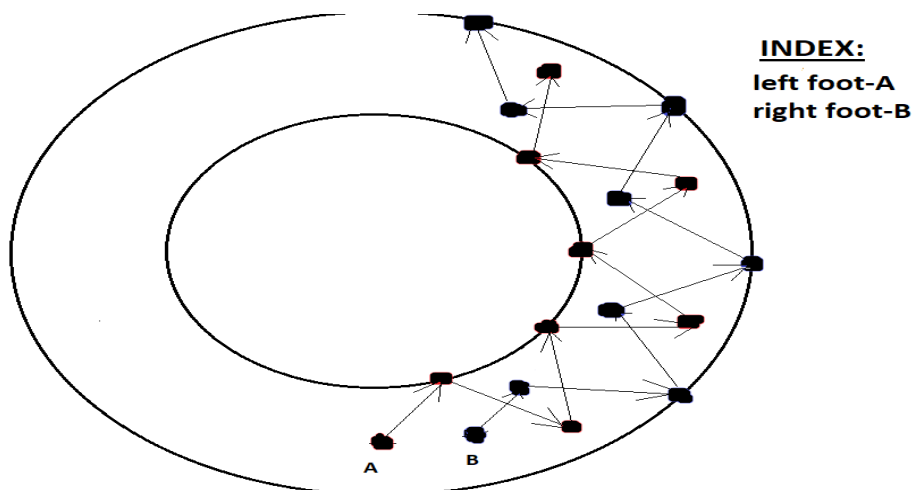


Fig. 2: Diagrammatic representation of footsteps of DeudaNaach

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

*Chhachhabarhachhaathara, chhathapyochubisa  
 Taabhayaugharbaribaaja, kyamaanaulatisa  
 (Six six twelve and six eighteen again add six twenty-four  
 You are already married what you love me)  
 Paanchpandabsayabhaaikaaurab Krishna kata tira  
 Kohunaankaskahunchhora Karan jastabira  
 (Five Panndav and hundred Kaurav, whose side be  
 Krishna?  
 Who and whose son vir Karan?)  
 Tin bhujatinaichhankonasabaikonaapsaathi  
 Jannelepuraskaarpaunenajanne le laathi  
 (Three sides, three angles and each angle sixty  
 degree  
 Who know get award and don't know get stick)*

*Dui dunaachaar, chaardunaaaath, aathdunaa sola  
 bhai  
 Tin junalaai sola syaupaanchpadi yak sheshrahi  
 (Two two ja four, four two ja eight and eight two ja  
 sixteen  
 Sixteen apples divided by three persons, each gets  
 five and remaining one)  
 Paanchsayabhedaakobagaal dui junagwalaa  
 Din raatabalekobaleidailekhjwalaa  
 (Five hundred flocks of sheep, two shepherds  
 Always burning flames of fire in Dailekh)*

## IX. CONCLUSION

Teaching geometry through chalk and dusters by just keeping students in the classroom is not effective. Since geometry is a subject of shapes, configuration, and pictures in itself, it is necessary to teach the students an experimental method to give them accurate knowledge. Geometry teaching is effective if students can be directly involved and taught to do it in their own local context. Therefore, it is found to be easy to give geometrical ideas and concepts to the school-level students of the Karnali region while teaching geometry through their popular Deuda dance.

It is well known that every dance is related with mathematics. Without mathematics no any dance is possible to conduct. DeudaNaach is a cultural Naach of western Nepalese people. In DeudaNaach, we can observe maximum use of geometric shapes as circles, curves, triangles, semicircles etc. through the player's footsteps, legs, hands and other body movements. On the other hand, mathematical statements (logic) are also used through Deuda songs. Players can question and answer mathematical logics through Deuda songs.

We (mathematics teachers) are tired of teaching mathematics in traditional methods in the 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 DeudaNaach in Karnali region which will be more practicable and entertaining. However, it may not fit to the students of other places due to the lack of knowledge about DeudaNaach.

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