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Musical activities for enhancing number concepts in preschool children

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Abstract
A concept is the basic unit of all types of learning. Young children generally form concepts through the use of senses. Number concept is defined by McIntosh et al. (1992), as a person's general understanding of numbers and operations. Research studies suggest that children construct basic number and arithmetic concepts gradually from experiences that involve numbers and difficulties in counting might hinder in mathematical progress (Baroody and Coslick, 1998). Therefore, attention should be given to assess and understand the number concepts formed during preschool age. Music is considered to play an important role in stimulating young children in learning. Hetland (2000) described that using songs and different music components can help in teaching numbers because of the high association between music and spatial-temporal reasoning skills. The study was carried out on twenty four numbers of pre-school children belonging to the age of 3- 4 years, selected through purposive sampling method. Pre and post-intervention design was used to assess the influence of musical activities on the development of number concepts in children. The number concepts were assessed in the categories of Number sense, Number representation and Number relation based on the principles of counting proposed by Gelman and Galistell (1978). It was found from the study that most children could name numbers but the concept of cardinality was not attained by many of the children. Findings revealed that children improved in all the areas of number concepts after the musical intervention. However, it was also observed that all the concepts are not mastered at the same time by all the children.

Keywords: number concept, music, pre-school children, assessment, musical activities

Introduction
Learning of numbers is an important part in the early years of children's life, because it provides vital life skills to children. Duncan *et al.* (2007) [4] states that providing the knowledge of number concepts to children at an early age is the strongest predictor of both later math success as well as success in other academic domains.
Difficulty with numbers is a common problem for children and it is considered as the most difficult subject (Samsudin *et al.*, 2019) [5]. Children often struggle to comprehend the concepts of numbers introduced in classrooms. An *et al.* (2008) [6] in his study found out that traditional way of learning mathematics creates mathematics anxiety and low grades in mathematics. This anxiety in children is caused because of lack of conceptual and activity based teaching methods. Teaching mathematics using effective didactic strategies like problem-solving activities, models, simulations, discoveries, challenges, and games may reduce the achievement gap and mathematical anxiety (NCTM, 2006) [7].
A variety of techniques and approaches has been studied to help children learn number concepts in a meaningful and stimulating environment. Using songs and different music components can help in teaching number concepts because of the high correlation between music and spatial-temporal reasoning skills (Hetland, 2000). Thaut and Kenyon (2003)[8], described that our bodies react physiologically to musical input, which means even the youngest children have the ability to inherently respond to music.
The present study was undertaken to assess the number concepts attained by preschoolers and to administer appropriate musical activities in educating number concepts among the pre-schoolers to fulfil the gap of interest. Music is considered to play an important role in stimulating young children in learning. It is highly social, natural, and developmentally appropriate way which restores memory, attention, language skills, gross and fine motor skills, social and communication skills (Henriksson-Macaulay, 2014) [9]. The natural similarities between music and mathematics (such as patterns, structures, and symbols) facilitates educators to develop lessons on numbers which can be integrated with various music concepts

such as music composition and musical instrument designs (Fauvel *et al.*, 2006) [10]. It was stated by Levitin (2006) [11] that children by the age of two starts showing preferences in music, they develop fondness for their own culture music. In the opinion of Awopetu (2016) [12], musical elements such as steady beat, rhythm, melody, and tempo (pace) possess inherent mathematical principles such as numbers, proportions, ratios, sequencing, counting, patterning, and one-to-one correspondence.

When instruction of number concept is integrated with music, it can effectively increase children's intrinsic motivation, because it fosters an enjoyable learning experience with more aesthetic engagement and accept more challenging tasks during learning (Glastra *et al.*, 2004) [13]. Music can also play the role of extrinsic motivation, if educators can facilitate learning of number concepts by using music to motivate children extrinsically. Children may have better concentration and become more cognitively engaged in learning numbers. Therefore, embedding musical activities into teaching numbers can help children in understanding number concepts and also provide them with a pleasant experience (An *et al*, 2008).

Music is an integral part of preschool teaching-learning process, but it is not frequently integrated in teaching number concepts. Thus, to motivate children towards mathematics, musical interventions can be used in teaching number concepts at an early stage.

Development of number concept-

There have been a lot of researches carried out in the field of development of number concepts to understand the child's thought processes as well as to discover best ways to help the child gain facility in working with number and numerical concepts.

Children normally learn to count in the following order: paying attention to numerical differences, recognizing a lot and too little, counting by imitating an adult, counting randomly from memory, rhythmic counting from memory, learning the rules of counting, counting by matching objects and number words; after this, children can count a group of objects and say how many there are (Aktaş-Arnas, 2006)[14]. Learning the rules for counting is an important step. They first must learn the order of number words accurately, count each object in a group only once, and attach a single number word to each object when counting. It takes time to learn these rules and the long process relies on following the right order for these subskills (Butterworth, 2005) [15].

Counting may appear verbally around age two but takes years to develop. A child may be able to count at age 2 to 3 but the order is often wrong. The order changes continuously, and age and experience bring increasingly more accurate counting. Five-year-olds can count rhythmically from 1 to 100 and if they make a mistake, they go back to the beginning and start over again (Ginsburg, 2009) [16]. Griffin (2004) [17] argues that the association of numbers and amount in five-year-olds leads to number sense and successful learning of arithmetic.

Methodology

Sample

Children belonging to the age group of 3 to 4 years were selected convenience and purposively sampling methods from a pre-school of Jorhat district, Assam. The reference period of the study was 2019-2020. A total of 24 numbers of children were selected, who were given musical intervention. The children were selected keeping in mind the homogeneity of age and socioeconomic background of children.

Assessment of Number concepts

Self constructed tool was prepared for assessment of number concepts of preschool children. It was conducted in the categories of - Number sense, Number representation and Number relation. The categories were based on the conceptual principles of number, given by Gelman and Galistell (1978) [18]. Those principles are:-

The categories were based on the conceptual principles of number, given by Gelman and Galistell (1978)

Principles of Gelman and Galistell	Definition	Category Used in the Research
The stable order principle	Number words must be used in a fixed order in counting	Sequencing
The one-one-correspondence principle	Every number word is assigned to one object in the counted set	Number Representation
The cardinality principle	The value of the last number word in the counting sequence represents the quantity of the counted objects	Cardinality
Magnitude principle	Higher number of objects is greater	Magnitude
The Relation principle	The relation between the numbers	Number Sense

After collection of data, raw data were categorized, coded, scored and tabulated for statistical computation. In tabulation the data were divided into different ranges on the basis of their capacity to know the number concepts. It was divided into 4 ranges, they are:

i. 4 - children who were able to know numbers concepts from 7 to 10 or above
ii. 3 - children who were able to know numbers concepts from 5 to 7 or above
iii. 2 - children who were able to know numbers concepts from 7 to 10 or above
iv. 1 - children who were able to know numbers concepts upto 2

Statistical analysis (Frequency and percentage was used to find out pre number concepts as well as to inspect the improvement in number concepts after intervention) was adopted according to objectives of the present study. The statistical analyses were carried out using Microsoft Office Excel. Findings were represented using appropriate graphs and bar diagrams. Post assessment data were compared with the pre-assessment data with the help of different charts.

Preparation and administration of musical activities

In the present study Orff [19] method was applied in teaching number concepts to children. The objective of the present study was to prepare musical activities that can help children to understand, enjoy, remember and apply certain number concepts. The music selected for the study was based on the sounds produced by Assamese traditional instruments such as *Dhol*, *Pepa* etc.

The interventional method was integrated with their normal school time-table. The focus of the present study was integration of music in teaching number concepts to pre-school children.

Table 1: Process of administration of Number concepts

<table>
<tr><th>Prepared Activity</th><th>Process of Administration</th><th>Picture</th></tr>
<tr><td>1) Number Sense:
1.1) Naming numbers
A audio clip was prepared where different beats of Dhol, distinctive for each numbers were played.
1.2) Matching number with number cards
It was prepared by combining different body movements corresponding to the numbers.</td><td>The researcher recited the name of numbers using the different beats (chap) of Dhol for each number name.
Children were asked to recite the number names along with the beats. Dance steps were taught as per the number sequence.
Later on each child has to hold different number cards and according to the received number card, children were expected to make the specified movement. This allowed children memorise and get acquainted with the numbers visually.</td><td>  </td></tr>
<tr><td>2) Number Representation
Identify the numbers with the beats of Dhol</td><td>The researcher beat the Dhol and each child was asked to identify the number of times Dhol was beat. For example: if the researcher played Dhol 3times, child needs to pick the card which has 3 written on it, which signifies that the child is able to represent the numbers according to the beats of Dhol.</td><td>  </td></tr>
<tr><td>3) Number Relation
3.1) Sequencing</td><td>In sequencing, the children were engaged in dance activities alongside counting of numbers. Counting of numbers with the dance step benefitted them to know that numbers always come in a set order
<table>
<tr><td>When child counts one</td><td>the right leg of child was moved apart</td></tr>
<tr><td>When child counts two</td><td>the child placed hands at the waist</td></tr>
<tr><td>When child counts three</td><td>the child tilted head towards right hand side</td></tr>
<tr><td>When child counts four</td><td>the head is moved to the centre</td></tr>
<tr><td>When child counts five</td><td>the child tilted head towards left hand side</td></tr>
<tr><td>When child counts six</td><td>the head is moved to the centre</td></tr>
<tr><td>When child counts seven</td><td>the child head was moved backward</td></tr>
<tr><td>When child counts eight</td><td>the child head bended forward</td></tr>
<tr><td>When child counts nine</td><td>the child brought head to the centre</td></tr>
<tr><td>When child counts ten</td><td>the child comes to previous position (removes hands from waist and feet’s joined)</td></tr>
</table></td><td> 
  </td></tr>
<tr><td>3.2) Cardinality
The activity for cardinality was prepared by the use of Dhol. (Times of Dhol was beat as per number assigned).
3.3) Magnitude
The activity was to align body movements with the beats of songs. This activity enabled children to recognise that higher numbers reflect larger quantities.</td><td>As the students were learning the beats of Dhol in number representation, therefore in this activity they were asked to beat the Dhol according to the number assigned to them.
In this activity children aligned their body movements with the beats of songs. Music of different frequencies was played and children have to match up the movements of the body with the increase or decrease in magnitude of music. More body movements for more beats.</td><td>  </td></tr>
</table>

Results and Discussion

1 Number sense

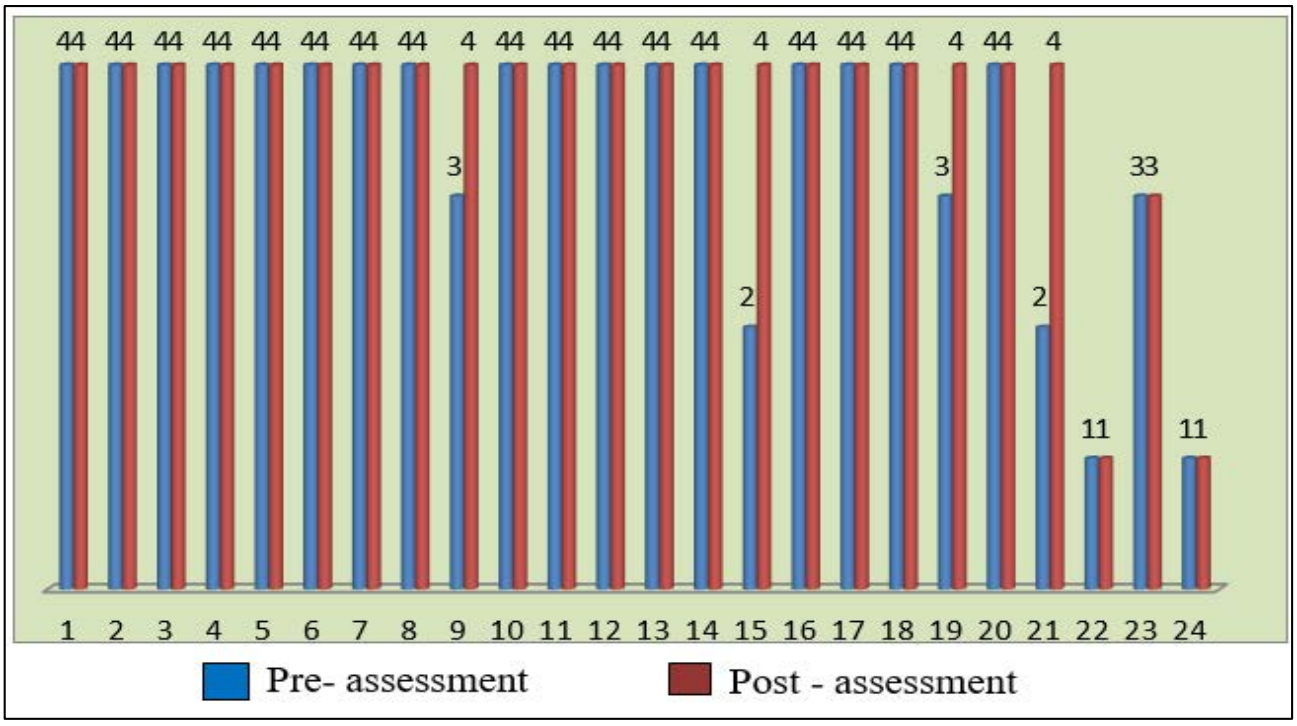

Fig 1: Post intervention responses of children in the category naming numbers.

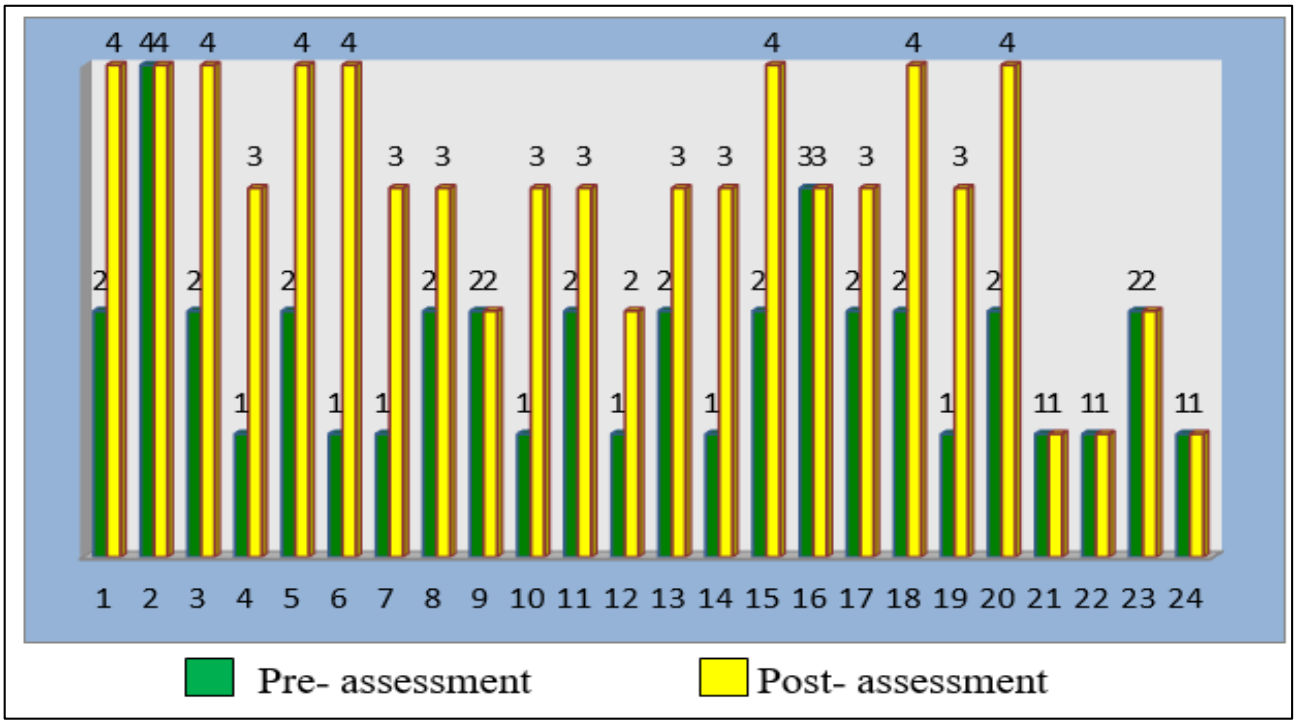

Fig 2: Post intervention responses of children in the category matching numbers with number cards

2. Number representation

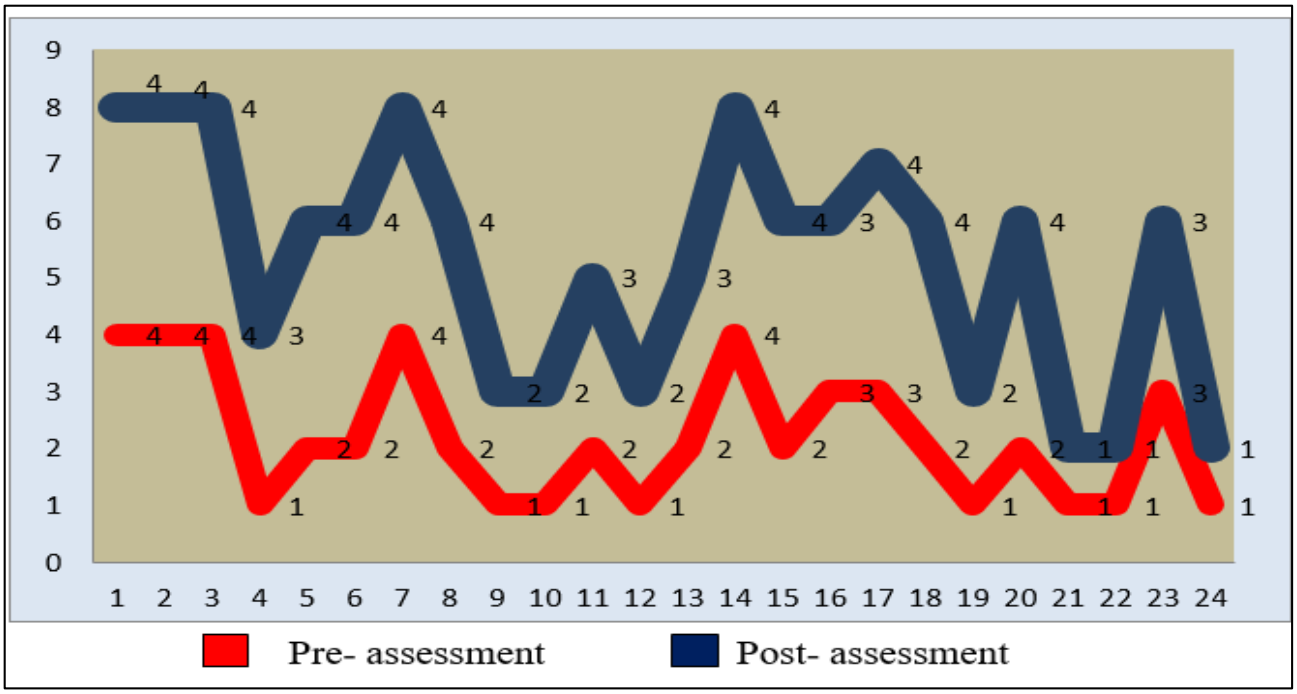

Fig 3: Post intervention responses of children in the category of number representation

3. Number Relation

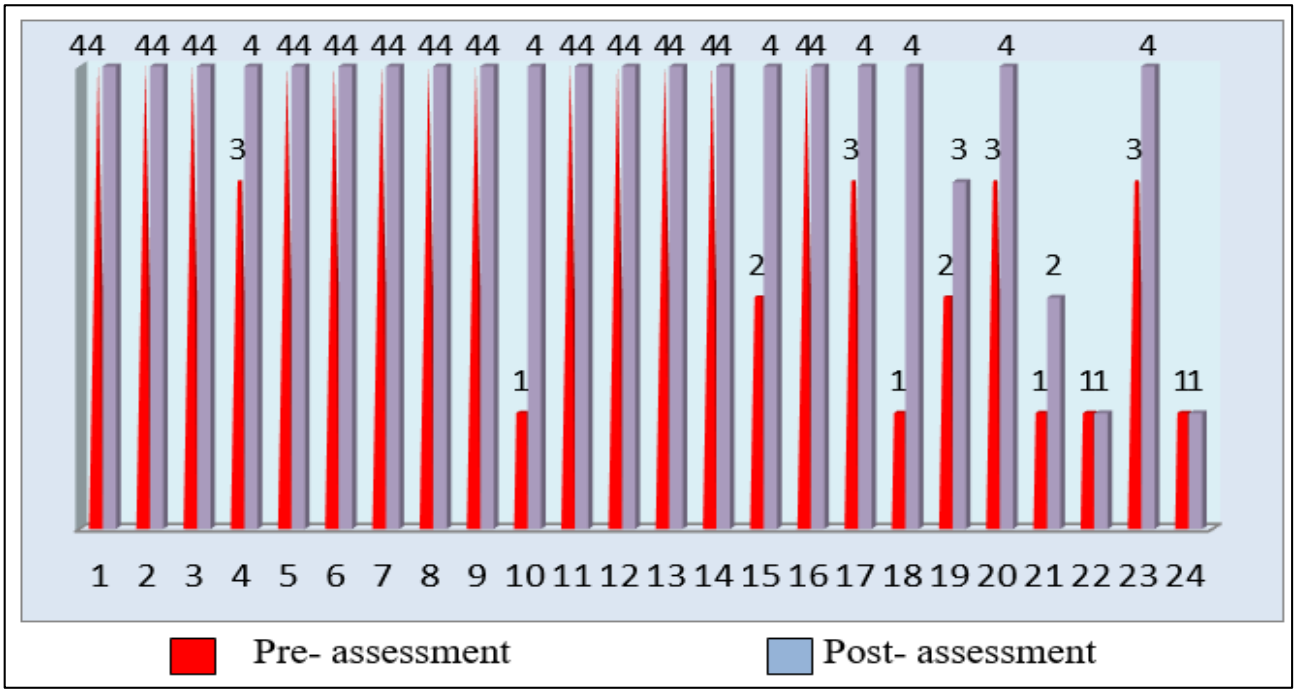

Fig 4: Post intervention responses of children in the category of sequencing of numbers

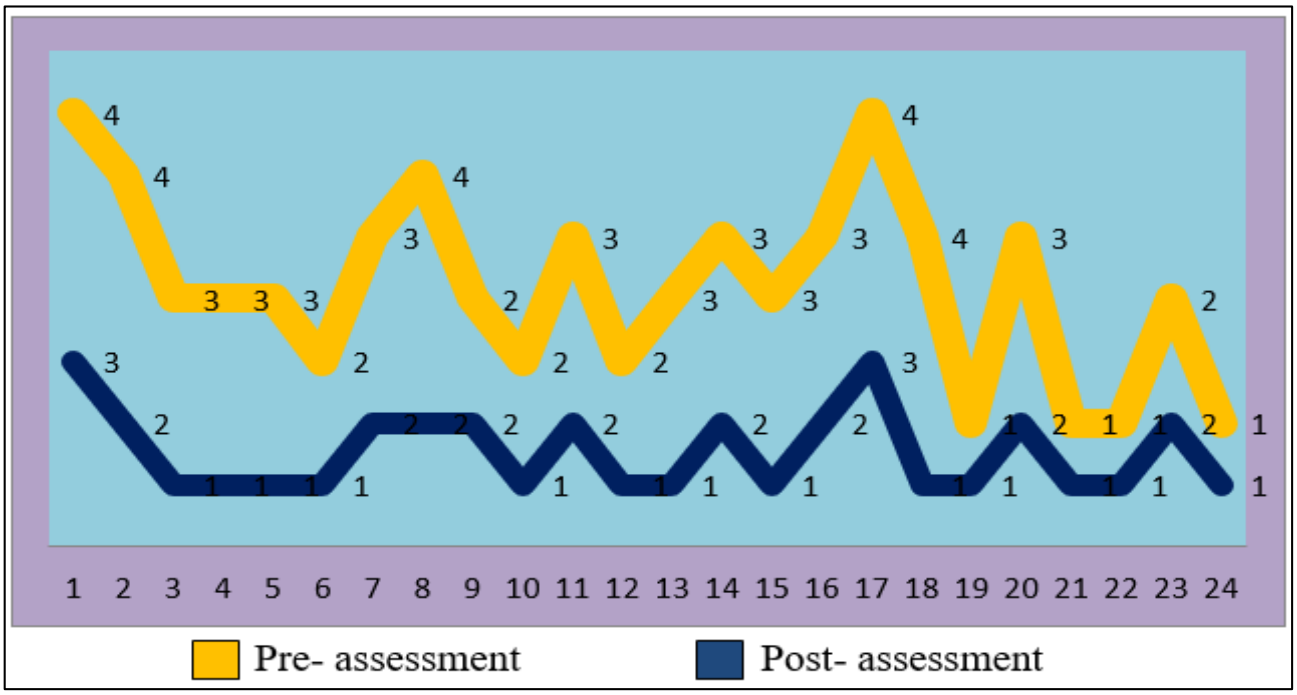

Fig 5: Post intervention responses of children in the category of cardinality of numbers

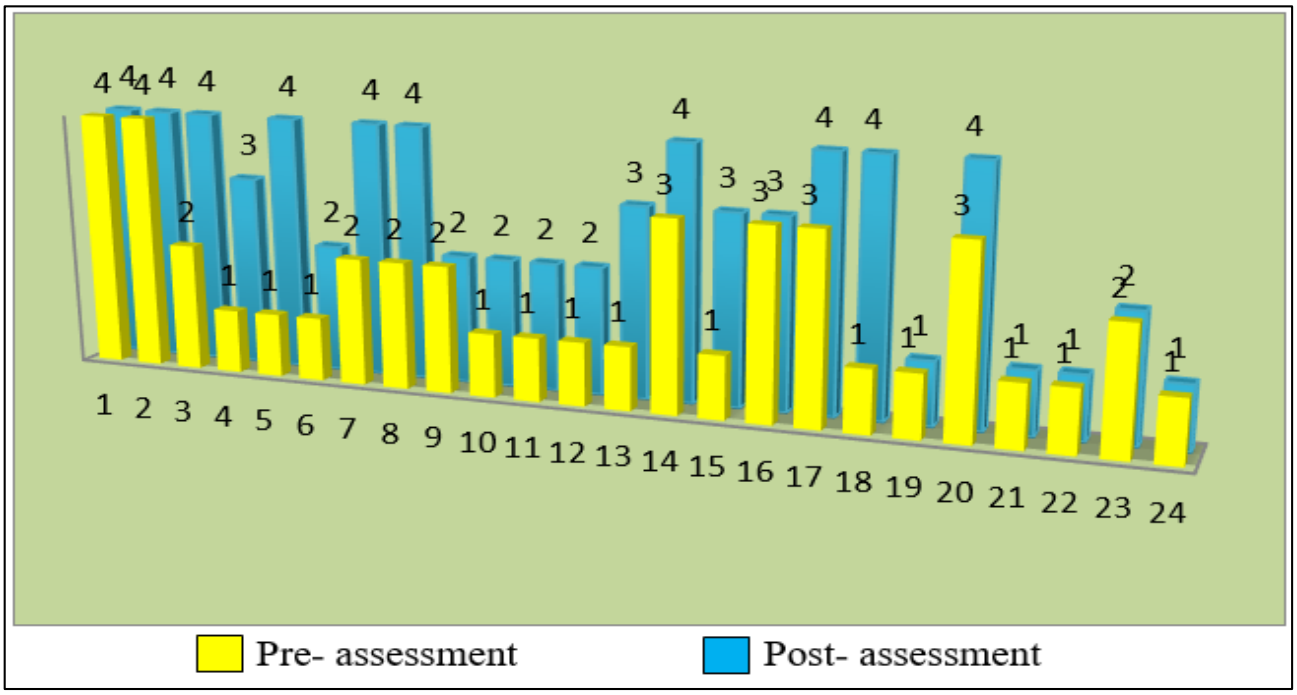

Fig 6: Post intervention responses of children in the category of magnitude of numbers

It was found that after the intervention, there was improvement in number concepts of children. It was also observed that children were attracted towards activities related to numbers, after conducting the music related interventional activities. The pleasant and joyful moments of music integrated learning increased attraction of children towards learning numbers. However, a few children who were irregular and inattentive, during the musical activities lagged in any such motivation and improvement during the assessment.

Among the three criteria selected in the study for development of number concepts, highest improvement was found in the concept of magnitude of numbers. The reason for more improvement in this area might be because the musical activity involved the whole concentration of the child and they enjoyed it. It was reported by Awopetu (2016) that encouraging children in dancing helps the brain to think in a linear mathematical way. Musical elements such as steady beat, rhythm, melody, and tempo possess inherent mathematical principles such as sequencing, and number representation (Geist *et al.*, 2012) [18]. Using songs and different music components help in teaching mathematics because of the high correlation between music and spatial-temporal reasoning skills (Hetland, 2000).

The concept of cardinality of numbers is much debated concept. Gelman and Meck (1983) [19] concluded that this principle is excelled at the age of three. Some others argued that the understanding of the principle begins at the age of three and a half (Wynn, 1992) [20]. Yet, some other researchers found that children could not determine quantities before the

age of four and a half and that principled understanding of cardinality does not appear before the age of five (Freeman *et al.*, 2000) [21]. In this study it was revealed, the performance of children in activities related to cardinality of numbers was poor among all the activities in pre-assement. Majority (54%) of the children could do number cardinality activity up-to the number 2 only. On the other hand, post assessment showed positive result; majority (41.6%) of children could cardinalize numbers from 5 to 7, which was followed by twenty point eight percent in the range of 7 to 10 or above. This is because young children learn best by exploring their surroundings, mostly through playing, during which they construct mental representations of the world (Hengeveld *et al.*, 2007) [22].

A least difference was found in the category of naming numbers. This may be because children had attained the concept of naming numbers at home or school in their early years or it can be obtained from everyday activities. Research studies have also suggested about the same (Ginsburg *et al.*, 2006) [23]; counting of numbers is the first formal beginning of mathematics that is learned by children (Al-Awidi *et al.*, 2010) [24].

Major Findings

The present study has revealed that all children possess number concepts in varying levels. And all the concepts are not mastered at same time. Butterworth (2005) stated that naming of numbers is mastered at the beginning and cardinality principle is mastered last.

Another key finding from the study states that, in pre-intervention assessment of number concepts, children performed better in the activities related to naming of numbers and performed poor in activities related to cardinality of numbers. After musical interventions were imparted to children, improvements occurred in the areas of number sense, number representation and number relation. Moreover, children who were irregular and inattentive, during the musical activities lagged in improvement in post-intervention assessment.

Thus, it can be suggested that musical activities can act as a stimulating tool in the early years' education for holistic development and it can also be integrated with mathematics curriculum to enhance the number concepts of preschool children. Van de Walle (2004) [25] states that, children who are exposed to early number concepts are likely to lead positive attitudes, values and beliefs about number concepts.

Conclusion

Music is regarded as a unique tool and aid in the teaching-learning process. Researches also reveal that integration of music with mathematics is quite beneficial. In opinion of An *et al.* (2008), mathematics lesson integrated with music had a positive effect on students' attitude and beliefs toward mathematics learning. Awopetu (2016) stated that benefits of using music not only for entertainment and relaxation purposes, but it also helps in early learning, especially in the areas of development of language, mathematical and social skills. Musical activities can act as a stimulating tool in the early years' education for holistic development. It was also observed that children are exposed to music in preschools but integration of musical activities in teaching number concept was not popularly used. Therefore, attention should be given in understanding and promoting number concepts formation through musical activities.

Limitation And Recommendation

The study was undertaken only in one pre-school and was confined to only a small sample size; therefore, the current findings and conclusions is limited to the groups examined at the time of this research. So, further an experimental study can be carried out to investigate the results of controlled group.

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