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Dikshitar's Music and Neurodevelopment

Effect of Background Music Intervention with Dikshitar's Nottuswaras on Cognition, Communication and Social-Emotional Learning in Preschool Children

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Abstract

Introduction:

The period from birth to six years is a critical period for child development. This is the period where there is an acceleration in brain development that in turn helps in the development of social-emotional learning, communication skills and cognitive abilities. In the West, there is an increasing focus on using music especially western classical music for enhancing child development and for developmental disorders in the preschool age. Music therapy or Raga Chikitsa has been used since very ancient times. Listening to music has always been considered soothing and healing, whether it is Indian music or Classical Western music or Folk Music. There are studies on music therapy with Indian classical music for children with developmental disorders and the use of Indian classical music as a background intervention but there are no well documented studies similar to the use of music in preschools in the West, with the use of Indian classical music in preschool children in India. This research study was undertaken to help address this gap.

Objective: The main objective of this research study was to see if background music intervention with Dikshitar's Nottuswaras could help enhance overall development, intellectual development, cognitive abilities, communication skills and social-emotional learning in preschool children.

Design and Method: In the present study, a quasi-experimental pre-post intervention study design was used. This involved an experimental and observational study. 45 preschool children in the age group of 3-5 years from a rural school in India were selected for the study. Thirty children were part of the concurrent experimental group and 15 children formed the historical control. The children in the experimental group were exposed to background music intervention with Dikshitar's Nottuswaras for a period of 16 weeks during non-classroom hours. The children in the experimental group were assessed at baseline and after the intervention with the Vineland Social Maturity Scale(VSMS) by Bharath Raj, The Development Screening Test (DST) by Bharath Raj and a development indicator checklist (PREDICT) developed by this researcher to determine the level of cognitive development, social-emotional learning and speech language and communication skills. The pretest and posttest assessment of children in the historical control group was done with the VSMS and the DST.

Results: There was a statistically significant improvement in overall development, cognitive skills, communication skills and social-emotional development in children in the experimental group who were exposed to the background music intervention as compared to the historical control group. These improvements were also corroborated by the findings of the qualitative observation study where the children showed subjective improvements in classroom behaviours, school performance, social skills, concentration, empathy skills and better peer relationships.

Index Terms: Dikshitar's Nottuswaras, Early Childhood Neurodevelopment, Carnatic Music, Cognitive Development, Social-Emotional Learning, Shankarabaranam Raaga

I. Introduction

"The fact that children can make beautiful music is less significant than the fact that music can make beautiful children." Cheryl Lavender, Master Music Educator, Composer, Author and Clinician

Early childhood neurodevelopment is now a much talked about and researched topic in present-day education and health care. However most of the research studies and activities in this area can be seen mostly in Western countries. The focus on early childhood development may also stem from the fact that there is an increase in neurodevelopmental disorders and specially Autism all over the world. Many of the preschools have realized the importance of promoting social and emotional development along with communication and cognitive abilities instead of just focusing on the three 'Rs' reading, writing and

math. Social-Emotional learning modules are now considered to be a vital part of the curriculum in public schools in USA. Research has shown that social-emotional development is crucial to brain development, cognitive development and development of communication skills. (1, 15,14,42)

Cognitive abilities and communication skills are tools of learning and expression we often take for granted. From the time that an infant comes into the world it learns to use crying or the capability to produce sound as a means to communicate. As the infant develops he/she learns to use different sounds and ways of crying to indicate needs and also to communicate feelings. The new mother can instinctively make out the needs and moods of the child in the distinct way that the infant cries when it is hungry, sad, and sleepy or just wanting to get attention. This goes to show that development of communication has a lot to do with social-emotional learning and inherent musicality.

Music and language are closely interlinked (Erin McMullen & Jenny R.Saffran,2004). In the same way music and emotions are also interlinked (Gunter Kreutz and Martin Lotze 2004, Stefan Koelsch 2014). Infants first start to recognize changes in pitch and tone before they understand the spoken word. The infant seems to have this instinctive ability to pick up variations in pitch and tone. They learn to distinguish between their mother's voice and a stranger's voice very early in life (De Casper and Fifer,1980). Recent research has shown that infants recognize and respond to songs or music that they had heard in the mother's womb (Peter G.Hepper,1991). There is an overlap in the areas of the brain that are activated while learning or listening to music and the areas for processing speech (Brown et al 2006). (31,29,28,16,24,25,9)

Studies have shown that infants start to hear sounds in the mother's womb at 28 weeks (Peter G.Hepper et al, 1994). Some studies demonstrate that exposure to relaxing music especially classical music during this phase helps brain development (Diane B.Bales, 1998), spatial reasoning, learning ability (Sraboni Chaudary et al, 2013), language development and neonatal behavior (Ravindra Arya et al, 2012). There are studies that have shown that infants retain memories of melodies heard while in the mother's womb (Eino Partanen 2013). Music also helps in creating a sense of calmness. This makes the baby in the womb feel safe, secure and happy. Early exposure to music could possibly help the child develop into an emotionally stable person. This might also help them pick up language and cognitive skills at a faster pace. There are a number of research studies that demonstrate the effect of music in improving social-emotional learning and communication skills in toddlers and preschool children. (25,4,13,3,34)

Music has been used across cultures at different stages of the child's development including at the stage when it is in the womb. In South Indian culture, the tradition of the "Srimantham" function during the eighth month of pregnancy apart from the other rituals involves playing the Vedas on the "Saraswati Veena" an Indian classical music instrument. There is also another ceremony during the fifth month of pregnancy that involves use of music. This correlates with the research studies that have found that the foetus starts to hear at 28 weeks of gestation. The sounds of the "Veena" are considered therapeutic. In India classical music both instrumental and vocal is used at different stages of the child's development and on important occasions such as birthdays and festivals.

From the above-mentioned facts it can be said that music as therapy can further augment or complement other extra-curricular and academic activities. Music can help to release energy blocks in the system and pave the way for an effective teaching and learning environment. Music therapy might also prove to be an effective tool not only in treating children with developmental issues but can also help in the process of normal development. (4, 10,28,13)

TYPES OF MUSIC

Music can be divided broadly into Indian music and Western music. Indian music can be broadly classified into Carnatic (South Indian music) and Hindustani (North Indian music). Indian music can also be classified into different types such as Folk, Devotional, Ghazals, Qawali, Bhangra, Film, Indi-pop and Fusion music. Western music also has different styles. Western classical music can be divided into Classical, Country, Pop, Jazz, Hip-hop, R and B, Blues, Heavy Metal, etc.

DIFFERENCE BETWEEN INDIAN AND WESTERN MUSIC

Indian music is essentially melody based and is developed with notes in a particular sequence that is repetitive and improvised upon. Western music on the other hand is polyphonic and is based on a number of different notes occurring together. Western music is based on harmony and the notes need to be played in a given order. Indian music is based on the raga system where a group of tones form a melody. (2,36,43)

Indian music has been around for thousands of years and has evolved into a complete art form. Music is something that is pleasing to the ear. The kind of music that evokes feelings of pleasure sadness or happiness may vary depending on the exposure to different genres from childhood. The environment in which the child is brought up also makes a difference to the kind of music they respond to. The *raaga* system is a concept that is unique to Indian classical music. The way the notes are structured and the variations in pitch, melody and rhythm have an effect on the way it affects the listener.

In yoga use of certain repetitive sounds like *omkara* or chanting of mantras in a particular tone create vibrations that

have shown to positively affect health, help maintain equilibrium in the human body, help preserve a state of optimal well-being, help quicker recovery from illnesses and have numerous other beneficial effects. Music in consequence can be any sounds or structured rhythm that is pleasing in addition to helping towards varying the mood or to relieve stress. The practice of music or listening to music takes the individual into a different world. It helps create a mental space for the individual that is entirely their own. A space that they can freely enter into and enjoy anywhere or at any time. Music is said to be like a friend with whom one can share all their joys and sorrows and thus lighten their burdens.

Music therapy can have a number of different applications. Research has found that music helps to change brain electrical-wave patterns. These patterns are measured using an electroencephalogram (EEG). Different wave patterns are recognized that indicate states of the mind and brain. Music helps stimulate the alpha wave state in the brain which is the state when one is relaxed and calm. It also helps give a pleasant feeling based on the music that the person listens to. If the individual is sad or depressed, when he listens to sad or melancholic music that matches his mood, it helps to express suppressed feelings. (6,7)

The method of teaching in Indian classical music is such that it helps to build a rapport with the guru or teacher. Learning music requires good concentration and focus. The mathematics involved in the *talas* or rhythms and learning to improvise on the *raagas* helps develop the cognitive and creative abilities in a student practicing music. There are certain *raagas* that are specifically used to evoke different feelings such as fear, anger, sadness joy etc. In Hindustani music certain *raagas* are sung only at particular times of the day that reflect the mood and atmosphere. There are many other interesting aspects of *raagas* that will be helpful when looked at from a therapeutic point of view. (35)

Western classical music especially compositions of Bach, Beethoven and Mozart have been shown to have therapeutic effects and help improve learning. A number of research studies have shown that just passive listening for a fixed period of time each day help improve classroom behavior, attention span, cognitive abilities and social-emotional learning in preschool, primary and high school children. (26, 22,32,33,39)
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II. EARLY CHILDHOOD NEURODEVELOPMENT AND HIGHER BRAIN FUNCTIONS

To understand how music can enhance early childhood development, it is important to understand aspects of brain development and basics of higher brain functions such as cognition, communication and social-emotional development. The following is a brief overview of the same.

CRITICAL STAGES IN BRAIN DEVELOPMENT

Research studies on brain development in infancy and early childhood have found that only the hindbrain is fully developed at birth but by the age of four years the child's brain is almost the size of the adult brain. Another interesting fact is that many of the nerve cells or neurons and neural networks in the baby are formed in the mother's womb itself and immediately after birth. Even though the new born baby has all the neurons required at birth, there is no meaningful connection or communication between them. This communication happens by the electrical stimulation that passes from one neuron to the next.

Neural networks are formed by groups of neurons firing together. In order to facilitate communication neural networks or pathways are formed by the neurons connecting together. The formation and maintenance of neural networks is dependent on their continued use and a number of other factors. The most important of them being the experiences the child has on a daily basis. This includes sensory experiences, the environment both physical and psychological that the child is exposed to and interaction with the people around. The neural networks are reinforced based on positive interactions with the environment. If this does not happen the neural networks decline or weaken.

This is the phase where the parents, teachers and caregivers have a significant role to play in providing a conducive and nurturing environment and have positive interactions in order to aid optimal growth and development of the child. The early childhood development manual produced by the UNICEF says that the period from zero to eight years is the time that is crucial to healthy cognitive, physical and emotional development of the child. (41,45)

DEVELOPMENT OF HIGHER BRAIN FUNCTIONS

COGNITIVE DEVELOPMENT

Cognitive development is the term used to mean development of the child's ability to think, learn, process and use information. The processes involved in cognition are memory, attention, organization, executive functioning and perceptual ability. It also includes language comprehension, problem solving abilities and abstract thinking. The development of cognition has historically been believed to be dependent on two factors nature and nurture. Cognitive development or the ability to understand and make sense of the world is believed to be the first step towards the development of speech language and communication skills. (41,42,20)

DEVELOPMENT OF SPEECH-LANGUAGE AND COMMUNICATION SKILLS

Speech language and communication skills involve the ability to first understand or comprehend communication. This is known as receptive language skill. This is followed by the ability to use words and symbols to communicate. This is known as expressive language ability. The toddler uses gestures or pointing to communicate, followed by babbling and then finally starts to use meaningful words and sentences. (41,42, 30)

SOCIAL-EMOTIONAL LEARNING

The importance of development of social and emotional skills from a young age has of late gained significance. Social-emotional learning is the ability to understand, manage and deal with positive and negative emotions, stressful life situations, adversity, to be able to set goals, empathize with others and build positive relationships.

According to the CASEL (Collaborative for Academic, Social and Emotional Learning) there are five core aspects of social and emotional learning namely self-awareness, self-management, social awareness, relationship skills and responsible decision making. Social-emotional learning is considered the key to the development of cognitive skills, communication skills and as a major contributor to the overall development of the child. (CASEL, 2015). (14,17,1,5)

SOCIAL-EMOTIONAL DEVELOPMENT AND DEVELOPMENTAL DISORDERS

In recent times one of the major developmental disorders of concern is autism. Autism is a developmental disorder where there are deficits in three main skill areas namely social skills, speech language and communication skills and sensory processing skills. One of the major issues seen in children with autism is in the area of social-emotional learning. If the history of the child is traced from infancy it can be found that there is delayed social-emotional development due to various factors such as poor attachment bonding or deficiencies of a nurturing environment or poor reciprocal responsiveness.

Research studies have shown that introduction of social-emotional nurturing in children with developmental difficulties who were emotionally deprived helped improve their cognitive and communication skills and development in other areas as well. (33,35)

SOCIAL-EMOTIONAL DEVELOPMENT IN RELATION TO COGNITIVE DEVELOPMENT AND COMMUNICATION SKILL DEVELOPMENT

One of the aspects of social-emotional development is joint attention. Research studies have shown that children whose joint attention is well developed acquire language abilities better. This also shows the interrelation between the development of social-emotional competencies and language development.

Development of cognitive abilities is also dependent on social-emotional learning as children who are emotionally deprived or under stress will not able to focus or concentrate. The natural inquisitiveness and the freedom to explore that facilitates learning will not be possible due to the emotional turmoil and the inability to manage stressful situations. Development of cognitive abilities will only be possible if the child has an anchoring influence both at home and in the outside environment. The child should be able to feel that there is something or someone to rely on in times of distress.

The early interactions that parents, caregivers, teachers or other responsible adults who come in contact with the individual in early childhood play a major role in the development of social-emotional competencies in the child. Attachment bonding is a very important aspect of the relationship between the child and its parents. Therefore, it is important to provide a nurturing environment both at home and in the school for social-emotional competencies to develop.

The way the child develops emotionally has a direct influence on forming neural networks that are responsible for memory, learning and organization. It is therefore imperative to provide a nurturing and receptive social environment for the child to develop the social-emotional capacity. Social-emotional development also has a direct impact on language development and cognitive development. Research has shown that delayed or impaired social-emotional development leads to delay in all areas of brain development including cognitive abilities and communication skills. (20, 35)

III. MUSIC FOR ENHANCING SOCIAL-EMOTIONAL DEVELOPMENT COGNITION AND COMMUNICATION IN NEUROTYPICAL CHILDREN

The effects of music can be seen starting from infancy, in the womb and across all age ranges including in adolescents and adults. Music helps in fostering brain development, cognitive development, language development, social-emotional learning and academic performance in healthy children and adolescents. Apart from this there are a number of research studies on the therapeutic benefits of music in children with developmental problems, and also children and adolescents with behavioral and emotional issues. Music also has shown to have benefits in improving overall health and well-being.

In a study by Krista L. Hyde et al (2009) it was found that musical training in early childhood for just 15 months helped brain development including structural changes in the brain that helped improve both motor and auditory skills.

In a study by Schellenberg (2005 and 2007) it was found that music lessons and listening to music helped improve performance in cognitive tests in both 5-year-olds and adolescents. In a study by Sylvain Morena et al (2009) it was found that music helped enhance communication abilities in 8-year-old children.

In a review study on social-emotional learning and music education by M. Nevra Kupana (2015) it was found that musical experiences help improve emotional intelligence because it aids the acquisition of skills related to proper understanding, assessment and expression of emotions. Music in addition also facilitates better understanding of emotions and better self-regulation which in turn supports intellectual development and the development of social intelligence.

In a research study by Susan Hallam (1998) background music intervention was found to enhance academic performance and reduce disruptive behaviors in children with behavioral and emotional problems.

There are a number of studies on the effect of Western Classical Music for neurodevelopment in early childhood but similar documented studies on enhancing cognitive development, speech language and communication skills and social-emotional learning in neurotypical children in India with Indian Classical music are hard to find.

One research study by Swati Swaminathan et al (2013) on the second language English comprehension skills of musically trained and untrained Indian primary school children found that musically trained children had better English comprehension and vocabulary skills than musically untrained children.

Another research study by Uma Gupta et al (2005) on the effects of listening to *raaga todi* on the flute in postgraduate students found significant increase in the alpha brain wave frequency and reduction in scores on the depression, state and trait anxiety components of a standardized scale. (21)

A research study to improve self-esteem of adolescents with background music intervention with Hindustani classical music (Mamata Sharma, 2012) found that there was a significant improvement in the self-esteem of the participants after the music intervention. Except for the research study on primary schoolchildren, most of the studies in Indian classical music are on adolescents or adults. There are some research studies on prenatal exposure to Indian classical music (Arya et al, 2012). (39,33,22,44,21,40,37,10)

IV. EFFECTS OF LISTENING TO MUSIC ON THE BRAIN

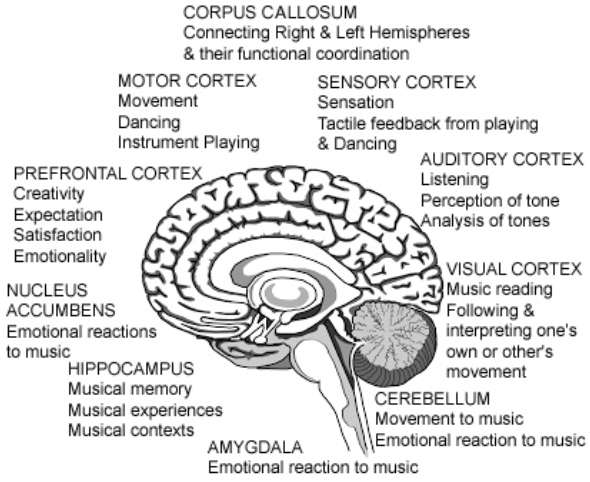


FIGURE 1: PROCESSING OF MUSIC IN THE BRAIN
(Courtesy: Modified from Wikimedia Commons)

Research studies have shown that listening to music or music therapy activates certain specific areas in the brain. Previously it was believed that the therapeutic effects of music were due to the enjoyment factor while listening to music and that it worked by stimulating the pleasure centers in the brain leading to the release of the feel-good hormone the endorphins. Although this is also true, it has been possible through modern investigative methods such as PET (Positron Emission Tomography) scan and functional MRIs (Magnetic Resonance Imaging) of the brain to track what exactly happens when a person listens to music. It was found that apart from the transverse and superior temporal gyri which are the primary auditory processing areas, the prefrontal cortex, the superior temporal gyrus and the precuneus of the parietal lobe, are also activated. The prefrontal gyrus, superior temporal gyrus and the precuneus of the parietal lobe are involved in some aspects of musical discrimination such as the pitch, melody, meter, timbre and rhythm.

The above-mentioned areas are also used by the brain for spatial reasoning. Long-term exposure to music has shown to improve reasoning ability in children. There was also an improvement in the electroencephalogram (EEG) patterns that helped to reduce epileptic activity in the brain. (6,7,9,15,26)

V. DIKSHITAR'S NOTTUSWARAS AND THE *SHANKARABHARANAM RAAGA*

MUTHUSWAMI DIKSHITAR AND NOTTUSWARAS

Muthuswami Dikshitar was a well renowned Carnatic Classical musician and composer who lived in the 18th Century. He was one of the revered trinities of Carnatic composers, the other

two being Tyagaraja and Shyama Sastri. He was born 1775 in Tiruvarur in the Tanjore district of Tamil Nadu to Ramaswami Dikshitar and Subbamma. Muthuswami Dikshitar's family in his younger age lived in Manali near Madras. At that time the Zamindar Venkatakrishna Mudaliar who was the patron of Dikshitar's family, used to take him and his brothers to Fort St. George in the erstwhile province of Madras. Here they got to listen to Western music played by the British band. His brother Balaswami Dikshitar was spellbound by the violin played by Irishmen in the band. Venkatkrishna Mudaliar arranged for Balaswami DIkshitar to be taught to play the violin by an Irish violinist. Balaswami Dikshitar then learnt to play classical music on the violin. Balaswami Dikshitar was the one who pioneered the use of the Western instrument the violin as an Indian classical music instrument.

Muthuswami Dikshitar composed 39 nottuswaras out of which 12 of them were based on original European tunes that he heard being played by the British band in Fort St. George. These tunes were modified by him. The nottuswaras were composed by him approximately in the 1800's. The exact time of composition of the nottuswaras is not very clear. Some texts say that the nottuswaras were one of his first compositions before he left for Varanasi. Some other texts say that he composed them after moving from Varanasi to Manali.

The compositions are in the *Shankarabharanam Raaga* with Sanskrit and Telugu lyrics. Some of the compositions were replicas of the British and Irish tunes to which Muthuswami Dikshitar added lyrics in Sanskrit and Telugu. These were in the *Shankarabaranam raaga* but with only the plain notes and without the usual embellishments of the *Gamakas* that are a common feature of Carnatic music. Muthuswami Dikshitar made minor changes even in these replicated English tunes that make it different from the original tunes. These were not just exact copies of the original tunes.

The Nottuswaras with "*Sahitya*" (lyrics) were published only later in 1905 by his brother's grandson Subburamu Dikshitar titled *Prathamabhyasa Pustakamulu* which meant songs for practice by beginners. It was considered a good practice lesson for beginners in Carnatic music especially young children as it was simple to learn and the tunes were attractive and catchy.

The Nottuswaras are a good fusion of Western tunes and Indian classical music with Sanskrit lyrics. The nottuswaras are simple and short therefore it will be easier for preschool children to learn. It could be potentially beneficial in enhancing their cognitive abilities, speech language and communications skills and social-emotional learning. In an article in the Hindu Kanniks Kannikeswaran, a notable musician and composer who has produced a CD on Nottuswaras titled Vismaya, mentions that nottuswaras could be taught to primary school children as an alternative to nursery rhymes. (Durga S.A.K.,1996, Kannik K. 2013). (19,27)

BRIEF DESCRIPTION OF CONCEPT OF *RAAGA*

The term *raaga* literally means that which pleases the mind. The *raaga* system is a unique feature of Indian classical music. A *raaga* is a melodic scale in Indian classical music with a particular or specific combination of *swaras* in a fixed sequence. It is similar to the modes in Western music. Each *raaga* in Indian classical music is unique not only because it has a basic set of notes or *swaras* with defined frequencies and intervals between them but also each note or *swara* in the *raaga* is connected to the base note or *aadhaara shadja*. There are fixed rules on how the combination of notes should be used. Individual improvisation is allowed within this fixed framework. The swaras starting from the base note increase in pitch or *sruthi* up to the seventh note or sixth or fifth note depending on the set of notes or *swaras* in the *raaga*, from the seventh, sixth or fifth note the *swaras* decrease in pitch to return back to the base note. The *swaras* in the ascending scale are known as the *arohanam* and the *swaras* in the descending scale are known as the *avarohanam* of the *raaga*.

The raagas are classified into two main types in Carnatic music namely *janaka* or *melakartha* or *sampoorna raagas* and *janya raagas*. The term *janaka* means generic and *janya* means generated or derived from. The *melakartha* scheme devised by Venkatmakhi was used to classify the *janaka* or *sampoorna raagas* and hence they are also known as *melakartha raagas*. The *melakartha raagas* contain all the seven *swaras* in both the *arohanam* and the *avarohanam*. There are 72 *melakartha raagas* in Carnatic Music. The *janya raagas* are derivatives of the *melakartha raagas* and they may or may not contain all the seven notes in both the *arohanam* and the *avarohanam*. Some *janya raagas* have seven notes in the *arohanam* but they may contain only five or six notes in the *avarohanam* or vice versa. (36)

SHANKARABHARANAM *RAAGA*

The *Shankarabharanam raaga* is one of the very ancient *melakartha* or *janya raaga* in Carnatic music. In the ancient system of classification, the *Shankarabharanam raaga* was derived from the *shadja grama* and was the *nishada murchana*. The *Shankarabharanam raaga* has existed from ancient times. It was considered as an important melakartha raaga or generic because of the combination of notes or *swaras* and *sruthi* intervals between the *swaras* in this particular *raaga*.

The *Shankarabharanam raaga* also known as *dhira Shankarabharanam* is the 29th *raaga* in the *melakartha* scheme of classification of *raagas*. This *raaga* has the unique characteristic of having an arrangement of symmetrical tetrachords in its musical scale. This mean that based on the intervals between the notes, the first part of the musical scale is

perfectly symmetrical with the second part of the musical scale. Each pair of musical notes or *swaras* have *shruthi* intervals between them which makes them into consonant pairs known as *samavadi swaras*. The consonance of the musical notes in this *raaga* makes it very aesthetic and pleasing to listen to and could also explain the soothing effects of compositions in this particular *raaga*.

Apart from *Shankarabharanam* only five other *janya ragas* or *melakartha raagas* from among the 72 have this arrangement. Interestingly the position of these six *raagas* in the *melakartha* scheme is the 1st, 8th, 15th, 22nd, 29th and the 36th with an addition of 7 starting from the 1st to the 36th *raaga*.

The *arohanam* (ascending scale) of *Shankarabharanam* is Sa, Ri2, Ga3, Ma1, Pa Dha2, Ni3, Sa and the *avarohanam* (descending scale) is Sa, Ni3, Dha2, Pa, Ma1, Ga3, Ri2, Sa. The *Shankarabharanam raaga* has its parallels in the Harmonic Diatonic scale or the C major scale in Western Classical music and the *Bilawal Thaat* in Hindustani music. All the nottuswara compositions by Muthuswami Dikshitar are composed in the *raaga Shankarabharanam*.

THERAPEUTIC EFFECTS OF *SHANKARABHARANAM*

The *Shankarabharanam raaga* is considered highly therapeutic. Music therapy research studies by certain organizations have found that this is an ideal *raaga* to reduce mental turmoil and other kinds of psychological ailments. There are some functional magnetic resonance imaging (fMRI) studies on the areas of the brain activated while listening to *Shankarabharanam raaga* (J.Satheeshkumar et al,2009). Studies of this particular *raaga* in early childhood development have not yet been documented.

COMPARISON OF *SHANKARABHARANAM* WITH THE WESTERN C MAJOR SCALE

In Western music, there are 12 divisions or frequency intervals between the seven notes in an octave but Indian Classical Music contains at least 22 divisions based on the *sruthi* intervals between the seven *swaras* in an octave. This is because of the division of the tones into microtones. The Western C Major Scale also contains all the seven notes similar to the *Shankarabharanam raaga*. The musical notes in Western music are usually rendered flat whereas the musical notes or *swaras* in Carnatic music are modulated with slight variations in the way each note is rendered. This would make the same melodies converted from the English tunes in the Western C Major Scale to the *Shankarabharanam raaga* have subtle differences when compared to the original English notes and sound different as well. The *Shankarabharanam raaga* has symmetrical tetrachords as mentioned earlier and each pair of *swaras* are consonant with each other known as *samavadi swaras* which is a feature that is absent in the Western C Major Scale. (19,27,36,38,43)

VI. MATERIALS AND METHOD

STUDY DESIGN

The study design used was an informal before and after experimental group and historical control group quasi-experimental study. The present study involved background music intervention with pre-test and post-test quantitative assessments and gathering of qualitative observational information of the children. No concurrent control group was used. In preschool classrooms in schools with limited space and resources it is not possible to have a concurrent control group because of the fact that indirect exposure to the intervention happens in all the children and hence it would be impossible to divide them into experimental and control groups in the same school.

The other possibility was to do assessments simultaneously at the time of starting the intervention and after four months in a different school without the intervention. This would have been practically difficult. Most school managements would not allow just repeated assessments to be done without any intervention or benefit to the children. The method chosen of using an experimental group with historical control group study design seemed to be more feasible for this particular study.

The need for using the historical cohort control group in quasi-experimental research in schools has been highlighted by Tamara (2014). This paper discusses the challenges faced in implementing evaluation programs in educational institutions. The difficulties in having control groups in schools are discussed. There are a number of reasons for this. These include ethical reasons such as denying treatment or intervention to one group of children and also the lack of resources. Most schools insist that the intervention be given to everybody which makes it impossible to have a concurrent control group. The lack of a control group makes it difficult to analyze the effectiveness of the educational program or intervention. To overcome this difficulty especially in school based interventions the use of the historical cohort control group is recommended. The historical control group is a control group taken from an earlier group that did not receive the intervention but is similar to the group receiving the intervention. The data for this could be obtained from previous data available with the school. Examples of studies that have used the historical cohort control group have been mentioned in the quoted study. The study concludes that using a historical cohort control group can be a feasible option to determine the effectiveness of school-based interventions.

SUBJECTS

The study was conducted on a sample size of 45 preschool children from a semi-rural primary school, 30 of whom were

exposed to background music intervention with Dikshitar's Nottuswaras in addition to the regular educational program. The other 15 children comprised the historical cohort control group who had attended a regular educational program. These children were without any exposure to background music intervention. The children were in the age group of 3 to 5 years. Most of the preschool children were from the local village and from lower socio-economic status backgrounds.

SAMPLING METHOD

The sampling method used was a non-probability purposive/ convenience sample. Initially the intention was to do the study in a school which would be located in a rural area and another school from an urban area. Several schools were surveyed for this purpose. The study was eventually done at a single school in a rural location.

The schools in rural and semi-rural areas were more open to both trying out innovative approaches and also to give time for activities that were not part of the standard school curriculum. The particular rural school selected for this study seemed appropriate due to the mix of children from mixed cultural backgrounds, different mother tongues, lower socio-economic strata and working-class home environments. Many of these children were from backgrounds where the literacy levels of parents were low and possibly it would not have been possible for them to have provided the children with an enriching environment. The facilities provided in local private and government schools in that area were also not adequate due to lack of resources. In these schools, children with mild development difficulties were also admitted into the regular school setup with no special provisions. Encouragingly, in that small rural area, the sense of community was higher and acceptance of differently abled children was also better.

In the urban private schools surveyed, surprisingly there was a lack of awareness and approachability by the management. The children had access to all facilities and they came from middle class or higher middle-class backgrounds. These children had all the opportunities and resources both at school and in their homes and therefore perhaps may not have required such interventions. The motivation both from the school management and the parents to allow the music intervention in the urban preschools approached was also very low.

VII. MUSIC INTERVENTION

The participants in the background music intervention were thirty (30) preschool children in the age group of three to five years. These thirty children comprised the experimental group. The historical control group consisted of fifteen preschool children who attended the same school in the previous academic year and whose academic records and other inputs were used for assessment purposes and were used for a comparative study.

The main intervention used for this study were the Dikshitar's Nottuswaras a form of Carnatic classical music that are based on English or Western classical tunes. All the nottuswaras used were in *Shankarabaranam raaga*. Initially it was intended to have an active music intervention program by having a dedicated period to teach Nottuswaras to the preschool children. Active music intervention could not be done due to a number of practical difficulties encountered. It was then decided to do a passive music intervention where the Nottuswaras were played in the background during non-classroom hours.

There are thirty-nine Nottuswaras. Among these eight were selected based on the tempo, melody and tunes that were considered to be simple and would hold the interest of younger children. The selected nottuswaras were a mix of songs with fast and medium tempos. Some of the tunes in the eight Nottuswaras were similar to popular tunes of English nursery rhymes.

The study was delimited to the use of Dikshitar's Nottuswaras based on the *Shankarabaranam raaga* in preschool children. The preschool children in the experimental group were those exposed to passive listening of the set of the eight Nottuswaras selected from the Vismaya music CD of Kanniks Kannikeswaran, played on a music system in the background twice a day for 15 minutes each time. They were played once in the morning at assembly time and again during lunch time. The average total duration came to 30 minutes a day for a total period of 16 weeks. The music intervention was done during the second term of the school from December to January 2015.

VIII. ASSESSMENTS AND MEASUREMENT

ASSESSMENT INSTRUMENT USED TO MEASURE NEURODEVELOPMENT:

PRESCHOOL DEVELOPMENT INDICATOR CHECKLIST (PREDICT)

The Pre-School Development Indicator Checklist (PREDICT) is a simple yet comprehensive checklist developed by this researcher for the specific purpose of this research study. It is a checklist that provides a measure of the neurodevelopmental indicators or developmental milestones of preschool children in the age group of three to five years across the domains of (1) Cognitive Skills (2) Communication Skills (3) Self-Help Skills (4) Motor Skills (5) Social-Emotional Skills and (6) Empathy Skills. The PREDICT checklist is based on widely used standardized measuring instruments. The PREDICT checklist provides a total overall score of 200 which measures

the overall or global development including intellectual, social-emotional, empathy, speech-communication and motor development. Individual sub-total scores for each of the six components can also be obtained. The PREDICT checklist development has been described in detail elsewhere (paper submitted for publication).

Other instruments used for comparison were the Vineland Social Maturity Scale (VSMS) Indian Edition and the Developmental Screening Test (DST).

VINELAND SOCIAL MATURITY SCALE (VSMS) INDIAN EDITION

The VSMS is a scale that measures the current child development across eight domains: Self-Help: General, Self-Help: Eating, Self-Help: Dressing, Self-Direction, Occupation, Communication, Socialization and Locomotion. The total overall score is a numerical score called the Social Quotient (SQ) and the average is 100. The SQ is comparable to the Intelligence Quotient (IQ).

DEVELOPMENTAL SCREENING TEST (DST)

The development screening test (DST) by Bharath Raj is a simple test designed to measure the mental development of children from birth to fifteen years of age. There are italicized items to measure speech and language which include all visible and audible forms of communication, items that measure adaptive behavior including sensorimotor adjustment to objects, people and situations and items related to personal-social behavior. The DST gives the developmental quotient (DQ) of the child which is comparable to the Intelligence Quotient(IQ). The IQ /DQ is calculated by the mental age that is synchronized with the actual age of the child with an IQ/DQ calculator and a standardized chart provided as part of the instrument.

QUALITATIVE OBSERVATIONS

The teachers were asked to observe the changes in the children both in behavior and in other areas. The qualitative observations included observations of the children during regular classroom activities, play time and other activities in the school and by the parents of their children's behaviors and activities at home. The feedback was gathered through informal interviews with the teachers and parents. Observations studies were also done by this researcher along during periodic visits to the school.

QUANTITATIVE ASSESSMENTS

The children in the experimental group were assessed before the start of the music intervention (pretest) and after the music intervention (posttest) with the PREDICT checklist developed by this researcher, the Vineland Social Maturity Scale (VSMS) Indian Edition by Bharat Raj which gives a Social Quotient (SQ) score and the Developmental Screening Test (DST) by Bharat Raj which gives a Development Quotient (DQ) score. The before and after SQ and the DQ scores were assessed for the children in the historical control group for the same time period in the previous academic year (from October 2014 to April2015).

The areas that were looked into with the assessments were overall development, cognitive development, communication skills, self-help skills, motor development and social-emotional development (measured with the PREDICT checklist), Social Quotient (SQ) measured using the Indian adaptation of the Vineland Social Maturity Scale (VSMS) and the Developmental Quotient (DQ) that is considered synonymous with the Intelligence quotient (IQ) measured using the Developmental Screening Test (DST).

This was done to see if the changes in the scores could be attributable to normal growth and development or due to the music intervention program. There are spurts of both physical and intellectual development in children in this age group and therefore since all the factors such as age, socio-economic status of the children and teaching practices were similar, it would help to see if the same level of progress was seen in both the situations: students with no exposure to music intervention and students exposed to music intervention.

IX. ANALYSIS AND RESULTS

RESULTS OF THE QUANTITATIVE ANALYSIS

Quantitative analysis of the pretest and posttest assessment scores was done using SPSS software were to determine if there was a significant effect of the background music intervention in the preschool children in the experimental group (N = 30) as compared with the historical control group (N = 15)

The pretest and posttest scores of the children in the experimental group (N = 30) and the historical control group (N = 15) in the PREDICT checklist, the VSMS and DST were analyzed. The PREDICT checklist was administered only to the children in the experimental group. The VSMS and DST was assessed in both the experimental and historical control groups.

A paired samples t-test and Repeated Measures Analysis of Variance (RM-ANOVA) on the pre-test and post-test measures in the PREDICT checklist of the experimental group and for all the components of the PREDICT checklist namely cognitive development, communication skills, self-help skills and motor development and social-emotional development in the experimental group was conducted. The self-help skills and motor development component were combined together. Since there was a noticeable improvement in the empathy skills of children in the experimental group, a paired samples

t-test and RM-ANOVA was conducted for pre-test and post-test scores in the empathy aspect of the social-emotional development component of the PREDICT checklist.

A paired sampled t-t test and RM-ANOVA on the pretest and posttest measures of the VSMS and the DST were conducted separately for the experimental and control groups. The comparison of the pre-test and post-test measures on the VSMS and DST in the experimental group and the control group was done with a Repeated Measures Analysis of Covariance (RM-ANCOVA) and RM-ANOVA.

T-TEST AND RM-ANOVA OF PREDICT TOTAL SCORES

TABLE 1: T-TEST OF MEAN PREDICT TOTAL SCORES

	MEAN	N	SD	t	df	Sig (2-tailed)
PREDICT-POST	183.50	30	8.885			.000
PREDICT TOTAL-PRE	132.63	30	15.032			
PRE-POST	50.86		8.258	33.739	29	

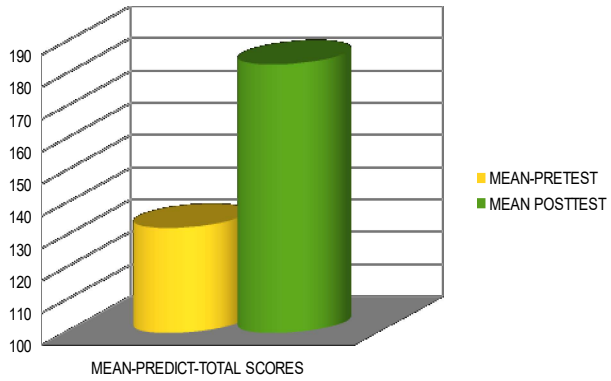
TABLE 2: RM-ANOVA OF PREEDICT TOTAL SCORES

MEAN SUM OF SQUARES	F	Sig	Partial Eta Squared
38811.267	1138.35	.000	.975

The results of the paired sample t-test experimental group determined that there was a significant increase in the mean posttest scores of the PREDICT checklist (M = 183.5, SD = 8.85) as compared to the mean pretest scores (M = 132.6, SD = 15.03) of children in the experimental group, t (29) = 37.7, p < 0.001.

The results of the Repeated Measures ANOVA with Sphericity assumed ascertained that there was a statistically significant difference in mean total PREDICT scores after the background music intervention (post-intervention) as compared to the baseline (pre-intervention) PREDICT scores, F value (29,1) = 1138.35, p< 0.001, η^2 = 0.975 (effect size).

GRAPH 1: MEAN TOTAL PREDICT PRETEST AND POSTEST SCORES



PREDICT TOTAL MEAN PRE-TEST SCORE = 132.63
PREDICT TOTAL MEAN POST-TEST SCORE = 183.50

T-TEST AND RM-ANOVA OF THE PREDICT COGNITIVE DEVELOPMENT COMPONENT SCORES

The results of the paired sample t-test demonstrated a significant increase in the mean posttest scores of the cognitive development subscale of the PREDICT checklist (M = 65.7, SD = 4.5) as compared to the mean pretest scores (M = 48.2, SD = 7.6) of children in the experimental group, t (29) = 21.039, p < 0.001.

The results of the RM-ANOVA of correlated samples with Sphericity ascertained that there was statistically significant improvement in the posttest scores of children in experimental group, in the Cognitive development subscale of the PREDICT checklist after the background music intervention (post-intervention) as compared to the baseline (pre-intervention), F value (29,1) = 442.6, p < 0.001, η^2 =.939 (effect size).

T-TEST AND RM-ANOVA OF THE PREDICT COMMUNICATION DEVELOPMENT COMPONENT SCORES

The results of the paired sample t-test showed that there was a significant increase in the mean posttest scores in the communication skills component of the PREDICT checklist in the children in the experimental group, (M = 27.67, SD = 1.56) as compared to the mean pretest scores (M = 20.33, SD = 3.29) t (29) = 16.85, p< 0.001.

The results of the Repeated Measures ANOVA (Table 4.3-4.6) of correlated samples with Sphericity assumed of the communication component of the PREDICT checklist showed a statistically significant improvement in the mean posttest communication component scores in the experimental group after the background music intervention (post-intervention) as

compared to the baseline (pre-intervention), F value (29,1) = 284.1, $p < 0.001$, $\eta^2 = 0.907$ (effect size).

T-TEST AND RM ANOVA OF THE SCORES OF THE PREDICT SELF-HELP SKILLS AND MOTOR DEVELOPMENT COMPONENT

The results of the t-test showed that there was a significant increase in the mean posttest scores in the self-help skills and motor development components of the PREDICT checklist in the children in the experimental group, (M = 32.1, SD = 2.09) as compared to the mean pretest scores (M = 25.9, SD = 3.77), t (29) = 8.79, $p < 0.001$.

The results of the RM-ANOVA of correlated samples with Sphericity assumed, showed a statistically significant improvement in the mean posttest scores of the self-help skills and motor development components of the PREDICT checklist in the experimental group after the background music intervention (post-intervention) as compared to the baseline (pre-intervention), F value (29,1) = 77.27, $p < 0.001$, $\eta^2 = 0.727$ (effect size).

T-TEST AND RM-ANOVA OF THE SCORES OF THE SOCIAL-EMOTIONAL DEVELOPMENT COMPONENT OF THE PREDICT CHECKLIST

The results of the t-test showed that there was a significant increase in the mean posttest scores in the social-emotional development component of the PREDICT checklist in the children in the experimental group, (M = 58.07, SD = 47.) as compared to the mean pretest scores (M = 38.27, SD = 7.68), t (29) = 23.78, $p < 0.001$

The results of the RM-ANOVA of correlated samples with Sphericity assumed, showed a statistically significant improvement in the posttest scores of the social emotional development component of the PREDICT checklist in the experimental group after the background music intervention (post-intervention) as compared to the baseline (pre-intervention), F value (29,1) = 565.8, $p < 0.001$, $\eta^2 = 0.951$ (effect size).

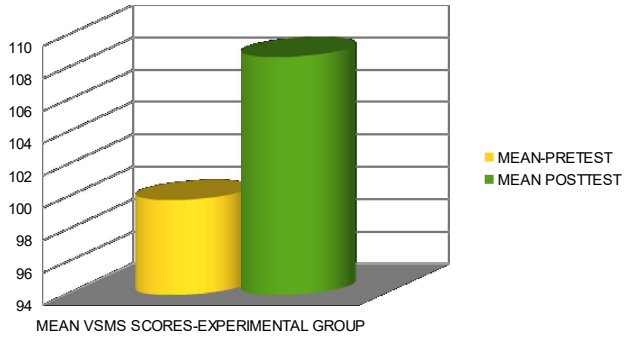
T-TEST AND RM ANOVA OF THE EMPATHY SCORES OF THE PREDICT CHECKLIST

The results of the t-test showed that there was a significant increase in the mean posttest scores in the empathy part of social-emotional development component of the PREDICT checklist in the children in the experimental group, (M = 8.2, SD = 1.5) as compared to the mean pretest scores (M = 4.2, SD = 2.2), t (29) = 13.0, $p < 0.001$.

The results of the Repeated Measures ANOVA of correlated samples with Sphericity assumed, showed a statistically significant improvement in the mean post-test scores in the empathy part of the social emotional development component of the PREDICT checklist in the experimental group after the background music intervention (post-intervention) as compared to the baseline (pre-intervention), F value (29,1) = 169.8, $p < 0.001$, $\eta^2 = 0.854$ (effect size).

T-TEST AND RM ANOVA OF THE VSMS SCORES OF CHILDREN IN THE EXPERIMENTAL GROUP

GRAPH 2: MEAN PRETEST AND POST-TEST SQ SCORES: EXPERIMENTAL GROUP



MEAN SQ: PRETEST: 99.9 POSTTEST:108.7

TABLE 3: T-TEST OF MEAN VSMS-SQ SCORES: EXPERIMENTAL GROUP

	MEAN	N	SD	t	df	Sig(2-tailed)
VSMS-SQ-POST	108.70	30	4.98	11.33	29	.000
VSMS-SQ-PRE	99.87	30	4.53			
PRE-SQ-POST -SQ	8.83		7.24			

TABLE 4: RM-ANOVA OF MEAN VSMS-SQ SCORES: EXPERIMENTAL GROUP SCORES

MEAN SUM OF SQUARES	F	Sig	Partial Eta Squared
1170.41	128.52	.000	.816

The results of the paired sample t-test of the mean VSMS scores of children in the experimental group determined that there was a significant increase in the mean posttest SQ scores in children in the experimental group (M = 108.7, SD = 4.9) as compared to the mean pretest SQ scores (M = 99.8, SD = 4.5) of children in the experimental group, t (29) = 11.33, $p < 0.001$.

The results of the Repeated Measures ANOVA of correlated samples with Sphericity assumed, showed a statistically significant improvement in the mean posttest SQ scores of the VSMS in the experimental group after the background music intervention (post-intervention) as compared to the baseline (pre-intervention) SQ scores, F value (29,1) = 128.5, $p < 0.001$, $\eta^2 = 0.816$ (effect size).

T-TEST AND RM-ANOVA OF THE VSMS SCORES OF CHILDREN IN THE HISTORICAL CONTROL GROUP

TABLE 5: T-TEST -MEAN VSMS-SQ SCORES: HISTORICAL CONTROL GROUP

	MEAN	N	SD	t	df	Sig(2-tailed)
VSMS-SQ-POST	99.27	15	2.84	.193	14	.849
VSMS-SQ-PRE	99.20	15	1.74			
PRE-SQ-POST -SQ	.067		.345			

TABLE 6: RM-ANOVA OF MEAN VSMS-SQ- HISTORICAL CONTROL GROUP SCORES

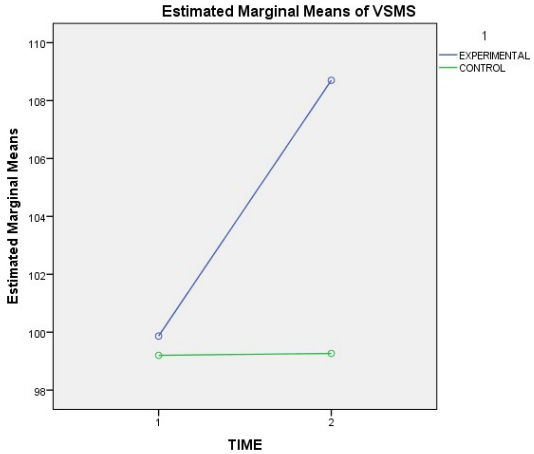
MEAN SUM OF SQUARES	F	Sig	Partial Eta Squared
.033	.037	.849	.003

The results of the paired sample t-test of the pre- and post-SQ scores of children in the historical control group showed that there was no statistically significant improvement in the mean SQ scores of the children in the historical control group, (M = 99.2, SD = 1.7) as compared to the mean pretest scores (M = 99.27, SD = 2.8) t (14) = 0.193, p = 0.849.

The results of the RM-ANOVA of correlated samples with Sphericity assumed, showed a there was no statistically significant improvement in the mean posttest SQ scores as measured with the VSMS in children in the historical control group who attended a regular education program with no background music intervention as compared to their mean baseline SQ scores, F value (14,1) = 0 .037, p=.849, η^2 = 0.003 (effect size)

COMPARATIVE REPEATED MEASURES ANOVA OF THE VSMS SCORES OF THE CHILDREN IN THE EXPERIMENTAL AND CONTROL GROUPS

COMPARISON OF SQ SCORES OF EXPERIMENTAL AND CONTROL GROUPS OVER TIME



CONTROL GROUP: MEAN POSTTEST SQ SCORE:99.27
EXPERIMENTAL GROUP: MEAN PRETEST SQ SCORE: 108.70

TABLE 7: COMPARATIVE RM-ANOVA OF MEAN VSMS-SQ SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS

MEAN POSTTEST VSMS-SQ		N	SD	F	Sig	Partial Eta Squared
EXPERIMENTAL GROUP	108.70	30	4.99	61.58	.000	.589
CONTROL GROUP	99.27	15	2.84			

A two-way RM-ANOVA was done to determine if there was a main effect of the background music intervention with Dikshitar's nottuswaras on the intellectual and social development in the preschool children who were part of the experimental group when compared with children in the historical control group with no music intervention as measured by the posttest SQ scores of the VSMS. It was found that there was a significant main effect of the music intervention program F (1,42) = 61.58, p = 0.000, η^2 = 0.589 (effect size) indicating that there was a significant difference in the mean posttest SQ scores of the experimental group (M = 108.7, SD = 4.99) as compared to the historical control group (M = 99.27, SD = 2.84).

T-TEST AND RM ANOVA OF SCORES ON THE DST OF CHILDREN IN THE EXPERIMENTAL GROUP

TABLE 8: T-TEST -MEAN DST-DQ SCORES-EXPERIMENTAL GROUP

	MEAN	N	SD	t	df	Sig(2-tailed)
DST-DQ-POST	107.03	30	6.37	7.50	29	.000
DST-DQ-PRE	99.40	30	3.28			
PRE-DQ-POST-DQ	7.63		5.57			

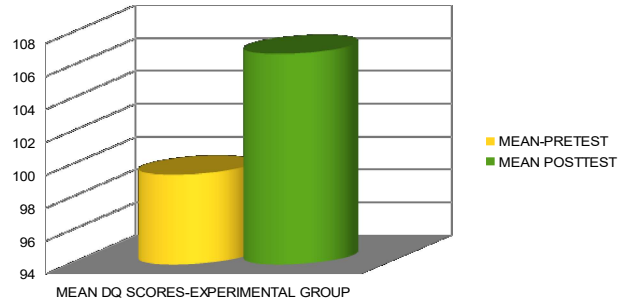
TABLE 9: RM-ANOVA OF MEAN DST-DQ EXPERIMENTAL GROUP SCORES

MEAN SUM OF SQUARES	F	Sig	Partial Eta Squared
874.01	56.26	.000	.660

The results of the paired sample t-test of the mean DQ scores of children in the experimental group determined that there was a significant increase in the mean posttest DQ scores in children in the experimental group (M = 107.0 SD = 6.3) as compared to their mean pretest DQ scores (M = 99.4, SD = 3.2), t (29) = 7.5, p = 0.000.

The results of the RM-ANOVA of correlated samples with Sphericity assumed, showed a statistically significant improvement in the mean posttest DQ scores as measured by the DST in the experimental group after the background music intervention (post-intervention) as compared to the mean baseline (pre-intervention) DQ scores, F value (29,1) = 56.26, p<0.001, η^2 =.660 (effect size).

GRAPH 3: MEAN PRETEST AND POSTTEST DQ SCORES-EXPERIMENTAL GROUP



MEAN DQ: PRETEST = 99.40, POSTTEST = 107.00

T-TEST AND RM-ANOVA OF THE SCORES ON THE DST OF CHILDREN IN THE HISTORICAL CONTROL GROUP

TABLE 10: T-TEST OF MEAN DST-DQ SCORES: HISTORICAL CONTROL GROUP

	MEAN	N	SD	t	df	Sig(2-tailed)
DQ-POST	99.67	15	1.29	1.00	14	.334
DQ-PRE	99.60	15	1.54			
PREDQ-POSTDQ	.067					

TABLE 11: RM-ANOVA OF MEAN VSMS-SQ SCORES: HISTORICAL CONTROL GROUP

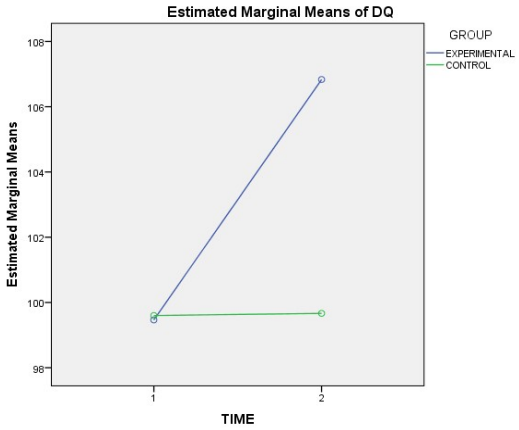
MEAN SUM OF SQUARES	F	Sig	Partial Eta Squared
.033	1.000	.334	.067

The results of the paired sample t-test of the pre- and post-DQ scores of children in the historical control group showed that there was no statistically significant improvement in the mean DQ scores of the children in the historical control group, (M = 99.67, SD = 1.3) as compared to the mean pre-test scores (M = 99.60, SD = 1.5) t (14) = 1, p = 0.334

The results of the RM-ANOVA of correlated samples with Sphericity assumed, showed that there was no statistically significant improvement in the mean post-DQ scores as measured with the DST in children in the historical control group who attended a regular education program with no background music intervention as compared to the mean baseline DQ scores, F value (14,1) = 1.0, p = 0.334, $\eta^2 = 0.067$ (effect size).

REPEATED MEASURES ANOVA OF SCORES ON THE DST OF CHILDREN IN THE EXPERIMENTAL AND HISTORICAL CONTROL GROUP

GRAPH 4: COMPARISON OF DQ SCORES OF EXPERIMENTAL AND CONTROL GROUPS OVER TIME



HISTORICAL CONTROL GROUP: MEAN POSTTEST DQ SCORE = 99.67
EXPERIMENTAL GROUP: MEAN POSTEST DQ SCORE = 106.83

TABLE 12: COMPARATIVE RM-ANOVA OF MEAN DST-DQ SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS

MEANPOSTTEST DQ		N	SD	F	Sig	Partial Eta Squared
EXPERIMENTAL GROUP	106.83	30	6.5	24.8	.000	.366
CONTROL GROUP	99.67	15	1.3			

A two-way RM-ANOVA was conducted to determine if there was a main effect of the background music intervention with Dikshitar's nottuswaras on the development in the preschool children who were part of the experimental group when compared with children in the historical control group with no music intervention as measured by their mean DST-DQ scores. It was found that there was a significant main effect of the music intervention program F (1,42) = 24.8, p = 0.000, η^2 = 0.366. There was a significant improvement in the mean post-test DQ scores of children in the experimental group (M = 106.83, SD = 6.5) as compared to the mean post-test DQ scores of children in the historical control group (M = 99.67, SD = 1.3).

QUALITATIVE OBSERVATIONS

SUMMARY OF OBSERVATIONS BY THE TEACHERS

The teachers reported significant improvements in the children's classroom behaviors. In the words of the school headmistress "The children are showing more focus, their attention span has improved and they are able to follow instructions better." One of the teachers observed that the children who were usually very noisy and hyperactive during lunchtime and in the classroom, had started to calm down after a few weeks of the passive music intervention. The head teacher also reported that the parents were spontaneously reporting positive changes in their child's behavior even at home and asking what had changed in the school. The

children were generally reported to be more cooperative, less prone to temper tantrums and showed improvements in their academic learning abilities.

SUMMARY OF OBSERVATIONS BY THE ASSESSORS

It was observed during the visits to the school by this researcher and another assessor that there were noticeable changes even in the children's behavior, social responsiveness, cognitive skills and social-emotional competencies as shown through their responses during interactions. The children were more interactive, responded better to questions and were better able to regulate their emotions. Children who were previously noticed to be aggressive and had difficulty making and keeping friendships in the class groups were later observed to be able to better adjust in the groups and gain acceptance from the other children. This was also corroborated by reports by the teachers.

One of the observations was with respect to twin brothers who were observed to have deficiencies in affect and social-emotional competencies but good in academic learning, grasping ability and memory. This could be observed from the lack of facial expressions and social smile during extended interactions. They did not seem to show expected levels of emotions or empathy towards their peers in distress. Following music intervention, a marked change was observed in their affect and behaviors. They appeared more expressive and animated and seemed to show better empathy and helpful behaviors in their peer interactions.

SUMMARY OF FEEDBACK FROM PARENTS

The feedback from parents was also positive. Parents reported improvements in academic performance, concentration, focus, attention span and behaviours. Parents reported that there was a reduction in disruptive behaviours, the children were calmer, considerate and cooperative at home as well.

SUMMARY OF RESULTS

The results of the quantitative analysis showed that there was a statistically significant improvement in overall development in children in the experimental group who participated in the background music intervention with Dikshitar's nottuswaras as measured by their mean total scores in the PREDICT checklist. There was a statistically significant improvement in Cognitive Development, Communication Skills, Self-Help Skills, Motor Development especially fine motor abilities and Social-Emotional Development as measured by their scores in the subscales of the PREDICT checklist in children in the experimental group. There was also a statistically significant improvement in the Empathy skills of children in the experimental group.

There was a statistically significant improvement in the overall intellectual and social development of the children in the experimental group as measured by the Social Quotient (SQ) scores of the VSMS scale which can be considered as equivalent to the Intelligence Quotient (IQ) when compared to the children in the historical control group. There was a statistically significant improvement in the Development quotient (DQ) scores of the DST which is synonymous to the Intelligence quotient (IQ) of children in the experimental group after the background music intervention when compared with the DQ scores of children in the historical control group.

The reports of the qualitative observation indicate that there were also subjective improvements in the children with respect to classroom behaviours, better focus and concentration, improvement in social skills, reduction in disruptive behavior patterns, better compliance, improved relationship skills and peer group interactions both at school and at home.

X. DISCUSSION

The main purpose of this research study was to see if introduction to a form of Carnatic music that was a fusion of Western classical music and Carnatic classical music could be beneficial in accelerating cognitive development, communication skills and social-emotional development in preschool children in the age group of three to five years. There have been a number of research studies on beneficial effects of the use of Western classical music in public funded pre-schools in USA but studies with Indian classical music as an intervention in regular pre-schools are difficult to find. There are a number of unique features in Carnatic classical music as compared to Western Classical music which may make it ideally suited for pre-school children.

The use of Carnatic music as a therapeutic modality with beneficial results have been demonstrated in adults in a number of different psychosomatic ailments such as depression, hypertension, diabetes and in children with developmental disorders. Studies similar to those in Western countries are either not available or not done till date in Indian preschools. This study was unique in the fact that a particular type of music namely Dikshitar's nottuswaras, a fusion of Indian and Western Classical music, was used in regular preschool children from a semi-rural background and low socio-economic status with possibly informal exposure to film and folk music but little prior exposure to Carnatic classical music or Western classical music.

One of the major contributions to the improvements in children could be due to the fact that the nottuswaras are composed in the *Shankarabharanam raaga*. The *Shankarabharanam raaga*

is one of the most ancient raagas in Carnatic music and was traditionally considered to have a high therapeutic value. The conversion of Western classical tunes into this *raaga* which makes it very different from either a pure Western classical music piece or a pure Carnatic classical music composition and combines the two forms of music could have contributed to the significant improvements seen in the children in all areas of development. The nottuswaras were in fact intended by Muthuswami Dikshitar to be used as practice lessons for younger children to make classical music lesson interesting for them. Some nottuswaras are even today used for teaching younger children in Carnatic music classes.

Sanskrit is also considered a language with a resonance. Research studies have shown the therapeutic benefits of recitation or listening to hymns or mantras in Sanskrit (Smita Chakraborty, 2015). The lyrics of the nottuswaras are mostly in Sanskrit which could have also contributed to the beneficial effect on early childhood development seen in this study.

The significant improvements in children in the experimental group could also be due to initiation of the relaxation response from exposure to the background music that could have helped reduce the effects of the stress response due to their possible difficult home circumstances. The background music exposure to Dikshitar's nottuswaras might have helped improve their autonomic stability thereby improving their social-emotional competencies and empathy skills that in turn could have helped accelerate development in cognitive and other areas. Studies have shown that social-emotional development is a key aspect that is crucial for the development of other main areas of higher brain development such as cognitive development and communication skills.

XI. LIMITATIONS AND SCOPE FOR FURTHER WORK

This study has several limitations. One of the main limitations of this research study is the small sample size. The study could be conducted at only one preschool centre in a rural set up due to a number of different factors. This made it difficult to do a comparative study of the effects of background music intervention and the difference in responses of preschool children from different populations such as urban, semi-urban and rural populations. It was also not possible to have a concurrent control group due to limited resources as in small classrooms that are closely situated all the children would be invariably exposed to the music intervention. To overcome this hurdle in this study, a historical control group was used for comparison.

Further studies could be undertaken using Carnatic classical music in preschoolers in India with different methods of music intervention such as active teaching, music making and group activities with music. This study could be replicated with a larger sample of children with a concurrent control group both with background music intervention or with active teaching of Dikshitar's nottuswaras. There could be a study of the autonomic effects of the use of Carnatic classical music in preschool children using measures of biological markers such as salivary cortisol levels to measure activation of the HPA axis and heart rate variability to measure the vagus response.

XII. CONCLUSION

Indian classical music has been used to advantage in many different situations and contexts in education and healthcare. This has somehow not percolated to the use of music as part of the regular curriculum or for fostering overall development in preschools in India. To the knowledge of this researcher, there are studies on use of India classical music to improve self-esteem, school performance and reducing stress in adolescents or college students but there are no studies on the use of Indian Classical music in Indian preschoolers.

This study hopes to help change this scenario and also provide a basis to justify the incorporation of Indian classical music into the daily school activities or even as part of the curriculum as a means of enriching the learning environment. The positive results of this study with the use of Dikshitar's nottuswaras that are a unique fusion of elements from both Carnatic classical music and Western classical music provides a strong argument for a larger role for music especially classical music in preschools in India. Classical music can in fact help not only accelerate cognitive development, communication skills and social-emotional development, it can also improve later school performance, class room behavior, reading abilities, writing abilities and social skills as well.

DECLARATION

I declare that this is my original work and I am the sole author. I have not received any support financial or otherwise from any source. Due care has been taken not to compromise on confidentiality. There is no potential conflict of interest with regard to the research or authorship of this work.

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