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Development of a music activities model to enhance brain development in children from birth to three years; Case study in Thailand

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Abstract

The first three years of a child's life are important for brain development, and music can play a significant role in enhancing such development. This research aims to devise a method of teaching music to children from birth-to-three-years old, which is designed to enhance brain development. In this qualitative research, classroom observation was carried out in three music classes. It was found that the classes comprised the most of listening activities, followed by movement and singing and playing activities. In addition, semi-structured interviews were conducted to explore four teachers' opinions on the role of music in brain development. All the participants reported a correlation between the two factors, attributing their responses to the observed student responses to the instructional activities managed in collaboration with the parents and the parental feedback. Also, an analysis of the effects of the music activities on brain development was performed by three experts. All concurred that most of the music activities had a direct impact on the students' memory and an indirect impact on their emotional development. Finally, a focus group discussion was held in which seven experts, including doctors, neuroscientists, and music professors, validated the conceptual framework guiding the present study and provided advice on the design of the lesson plan and specific activities. This data collection was used to gain more understanding of the relationship between music and the development of the brain functions of memory, language, thinking and emotion. The best practice music activities model that aims to enhance brain development in young children should comprise three stages: (1) Motivation: stage of attracting children to music activities; (2) music engagement & enjoyment: stage of using music's function to enhance brain development; and (3) reflection & feedback: stage of evaluation. These three stages can be achieved through cooperation between teachers and parents plus a knowledge of brain development and a systematic teaching plan.

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Introduction

It has been shown that music activities, even passive activities like listening, or active such as singing, movement or playing an instrument, can affect brain development in childhood (Kraus, 2015a). Research has shown that brain cells in children from eight months to three years old will start to spread out and form synapses, the sites where electric nerve impulses transmission occur (Kubota, 2016). During this period, the synapse growth is at maximum density and can create neural networks of 1000 trillion connections, twice the adults' amount. The synapse networks develop rapidly at this early stage as a child is continuously learning new things and encountering new experiences. With this development process, the number of synapses increases to approximately140 million connections by forming neural networks. This high density of synapse growth will start to dissipate after three years old and decrease over time. Some cells that are not stimulated before three years old will be subject to pruning (becoming extinct and unusable) (Restrack, 2006). Therefore, the birth-to-three period is critical for brain development and is the most effective time to introduce brain development activities to a child. During these early stages, parents are in an ideal position to offer productive activities to enhance their child's brain. Therefore, parents should understand the process of cognitive development from the birth-to-three. According to the classification by Piaget (1952), before three years old is the Sensorimotor Stage, moving to the Preoperational Stage (two to seven years old). During these stages, learning occurs through the combination of two processes: assimilation and accommodation, using a combination of sensory and motor skills to learn about surrounding things. In other words, children during these ages will learn best with a "learning by doing" approach. Musical activity is a tool that can be designed to accommodate the developmental needs in each stage to help them understand the element of music, such as pitch, rhythm and dynamics together with other skills like listening, singing, playing an instrument or movement (Suttachitt, 2018). Therefore, music activity is one of the most enjoyable activities for children and one of the most suitable approaches to enhance both sides of the brain during the early developmental period.

With the right learning tools, children can realize their potential, and music is one of those tools. It has been said that "Food is important to the growth of the body as much as music is important to the growth of brain" (Collins, 2015). Previous research focused on the effects of music to enhance brain development. It demonstrated that music can help children under the age of three develop their brains in a variety of areas, including memory, language, reasoning, and emotion. However, each subject is studied separately as it is difficult for teachers to integrate music activities in the classroom. Furthermore, there is no comprehensive music model that includes the instructional strategies, musical elements and skills, and the impact on brain development. These factors prompted a study in Thailand that aimed to develop a music activities model that would help children from birth to three years old develop their brains through observation, interview, and focus groups from experts. This research aims to devise a method of teaching music to children from birth-to-three-years old, which is designed to enhance brain development.

Literature Review

Music to Enhance Brain Development of Preschool Children

This section looks at numerous neuromusic research on memory, language, thinking, and emotion, as well as child development and music development.

Memory

Memory development is a part of cognitive development, which involves the hippocampus function of the brain that has been present since birth. This function is used by memorizing the voices of the child's parents. In the neonatal period, an infant has short term memory and needs to be consistently stimulated through the senses to convey the information from the nervous system to the brain (Partanen et al., 2013). This helps with coordination and increases the memory storage capacity to the extent that the infant could remember the data accurately for a longer time. Moreover, passive music activities, namely, listening, can stimulate the memory functions (Plantinga & Trainor, 2005; Saffran et al., 2000; Trainor et al., 2004). However, active music activities, e.g., movement, singing, or playing, can stimulate more (Mehr, 2017). Children can acquire a more significant and more prolonged memory for a lifetime, on the condition that they should have some music experiences before seven years old (Brandl, 2011). The memory storage capacity could increase by repeating music activities regularly to stimulate the sensory system (Pejarasangharn, 2020; Trehub et al., 2009).

Language

All humans have been innately gifted with communication either through speech or body language from birth. Studies asserted that every language could be deconstructed into the music elements of pitch and rhythm (Kraus, 2015b; Nan et al., 2018). For example, the latter influential element, the pitch is often found in Thai language or other tonal languages, in which a change of mark tones could vary the meaning of a word. In Thai language, one word consists of a flat tone or either a mark of low tone, falling tone, high tone, or rising tone, thus the different pronunciations of each word depend on the tone marks per the music element of pitch. Similarly, the Thai words หมา or măa (dog) and ม้า or mâa (horse) have different pronunciations and definitions. Still, both could be mistaken as the same word by foreigners who use English or other non-tonal languages (Sittiprapaporn, 2020). Everyone can use rhythm and melody for communication in every age group. Musical ability can develop naturally alongside language development (Trehub, 2015).

The brain builds neural networks stimulated by listening, sight, speaking, and movement extending its capacity to use language and communicate with others (Kraus et al., 2014; Plitakul, 2020). In particular, Broca's area is a region in the brain's frontal lobe with functions linked to speech production, vocabulary, and grammar. In addition, self-movement or playing of percussion instruments can also stimulate the production of axons within the brain, which leads to neural networks within the parts of the brain that are important to brain development (Trollinger, 2010).

Thinking

Thinking is an advanced skill associated with many parts of the brain (Kubota & Kubota, 2018). These parts include essential factors, such as emotions and memory (as working memory). Working memory is a part of thinking that music can affect (Pejarasangharn, 2020), as the academic works of Professor Nina, a specialist at the Music for Cognitive Science Department demonstrated, whereby those who had played music regularly had a more efficient auditory working memory than those who hadn't played music because music learning required connectivity between the various parts of the brain, which would be stimulated to co-work simultaneously (Jantzen et al., 2016; Skeie, 2018). This part of the brain will start to function as early as six months of age, but its impact could be more noticeable for children around the age of two and above through various music activities (John, 2020; Malloch & Trevarthen, 2018). These covered many different music skills, such as discrimination of sounds' music elements, e.g., pitch or dynamics, movement along with beat-rhythm, tempo, rhythmic pattern, or even improvisation of new lyrics in a familiar song melody along with creating movement, which will affect for mental flexibility skill

Emotion

Music has such a deep connection with emotions that it is referred to as "The language of emotion" because the musical sounds profoundly affect emotions and feelings deep down, even as far as the nerve cells and brainwaves (Korsakova-Kreyn, 2019). Music also boosts a human's high-level intelligence and directly affects limbic and paralimbic parts of the brain to create emotional simulations by listening to several kinds of music. This is essential for getting ready to cope with a wide range of emotions contingent on everyday life. Although infants do not understand all of a particular language, they could be fully aware of what their parents are talking about through the emotion of voices or the tone that they are using when communicating with each other (Collins, 2017). For this reason, parents could use their voices to express love and care towards children (Volkova et al., 2006).

Human emotion can be associated with the limbic parts of the brain, by which every human has the ability of emotional perception and emotional expression. These emotions can be processed since birth and are most commonly found through listening, movement, and touch (Zentner, & Eerola, 2010). Furthermore, grownups can also perceive and express many kinds of emotions and use multiple music skills, such as listening, singing, playing, and movement, all of which can be compared to musical terms (Cirelli et al., 2019). According to the preceding process of musical functions for emotional development, sounds were perceived into the brain's auditory cortex to analyze and discriminate elements of those sounds and then reflect them through motoring. Concurrently, the amygdala in the brain released dopamine, the hormone of happiness, to enhance the brain's attentional capacity and the nervous system that would increase the ability to learn and remember. Music elements, e.g., rhythm (beat-rhythm, tempo, and rhythmic pattern), pitch, and dynamic, affected emotions in several ways.

Educational Models

The educational models guiding this research were Steiner's model and the CIPPA model. Steiner's model was selected since the conceptual framework clearly specifies the basic elements of an educational model, namely, teachers, students, content, and context, and their relationships. Meanwhile, the CIPPA model was incorporated as it is a child-centered instructional approach comprising five elements, namely, construction, interaction, physical participation, process learning, and application, believed to be conducive to young children's learning.

Steiner's Model (Steiner, 1988)

Prof. Dr. Elizabeth D. Steiner, a professional in philosophy, explains that education is aimed at guiding learning. She claims that a comprehensive instructional model must consist of four crucial components (teachers, students, content, and context, otherwise referred to as TSCX). Any instructional model in which any of these elements is missing is regarded as incomplete (Suttachitt, 2018).

1. Teacher means a person who suggests and shows different ways to learn.

2. Student means a person who is receiving knowledge to develop their intelligence.

3. Content means the structure to create the energy of students which contains Cognition (thought), Contemplative (intent), and Affective (emotional) aspects such as process, content, curriculum, and content of music education.

4. Context means learning elements such as teaching technic, layout, equipment, and media

CIPPA Model (Khammani et al., 2005)

It is a student-centered teaching model that gives the learner the ability to become the creator by themselves, developing physical, emotional, social, and cognitive skills. The teacher will create the teacher and learner's participation activities until they can apply these activities to their daily lives. CIPPA is an acronym standing for:

C = Construction of knowledge, meaning that the teachers are responsible for helping learners understand the learning process and guiding them.

I = Interaction means participation between teachers and learners, surrounding people, or other methods that rely on each other.

P = Process Learning means the learner studies the process of thinking, doing, finding knowledge, problem-solving, and teamwork.

P = Physical participation/Involvement means the learner is doing activities with their body to awaken the aged sensory-motor skills.

A = Application means the learner is learning by understanding deeper and forming a connection between theory and practice.

Methodology

The research included observations of early childhood music classes and interviews with classroom music teachers in Thailand, as well as a focus group with Thai experts working in the field of music and brain development.

Observation of Pre-School Music Classes and Interviews with Teachers

This research was conducted to examine the relationship between music activities and brain development in very young learners from birth to three years of age, which is regarded as the golden period of brain development. The classes being observed did not have music activities model specifically aimed at enhancing brain development. In this stage, the data were collected between February to April of 2020 through three main methods: interviews with music teachers, classroom observation, and analysis of the role of music activities in brain development.

1. The interview with the music teachers focused on the teaching of children aged from newborn to 3 years old who live in Bangkok metropolitan region. Interview topics consisted of the experiences, principles, teaching method, and teaching contents, including the point of view for musical development.

The researcher had selected the sampling of 4 music teachers who had to meet the required conditions listed below:

Qualification criteria for the teachers:

- Participants had to have a musical degree.
- Participants had to have experience in teaching music for over three years.
- Participants had to have experience in teaching music to children below five years old.
- The objective of the participants' music teaching had to include the development of other capacities, in addition to music.
- Participants had to agree to participate in this research by signing the consent form stipulated by the Human Research Protection Unit, Mahidol University.

2. Class observation: Upon observing music classes of birth to three years old, the researcher used the class observation form generated by the study of relevant research and took on a non-participant observer's role.

3. Data collection: The materials used to conduct the interviews comprised an interview question form, a voice recorder, research ethics form and the observation form. A voice recorder and video camera were used for observation. The recorded footage from the class observation would be used for analysis and then permanently deleted from the database after completing this research.

4. Data analysis: Inductive analysis was applied by summarizing the interview data's key points, analyzing the content to classify critical issues and comparing each expert group's perspectives. Also, the recorded observation data were used to classify and compare details and musical elements to present in the form of tables.

Interview with Experts to Develop the Music Activities Model

1. The researcher summarized, analyzed, and compared the data gathered from interviews with the experts and music teachers, together with the results of the research. The first phase was to construct a theory and illustrate it as an abstract conceptual framework.

2. The key factors related to the relationship between music and brain development were drawn from the data analysis and used to develop the music activities. These music activities were designed to enhance the brain development of birth to three years old.

3. Focus groups were used to ensure the validity and reliability of the research (Urwongse, 2019), used to validate, and the results and the effectiveness of the musical activities on enhancing children's brain development. The focus group participants consisted of experts and music teachers. The seven participants consisted of two Doctors, three Neuroscientist and two Music Professors on August 13, 2020. The researcher used a voice recorder at the focus group meeting to collect the data. The essence and guideline of the music activities model were summarized and discussed during the meeting.

4. The music activities model that could enhance children's brain development was re-evaluated and improved according to the data collected from the focus group.

Results and Discussion

Analysis of the Musical Activities through Class Observation and Interviews with the Teachers

Classes in three from six established international music programs in Bangkok aimed at early childhood were observed. Dissemination of the program details is prohibited due to copyright laws. According to the interview findings, all teachers had at least a master's degree in music.

Figure 1 shows that the classes in the three music programs were observed against the checklist. It was found that all 44 activities, aimed for very young children aged 0 to three years, predominantly involved the recognition and development of beats, rhythms, tempo, pitch, tone, and dynamics. Among these activities, 34 focused on listening skills, 33 on movement, 25 on singing, and 17 on playing a percussion instrument.

Each period of the children's life featured different activities. When they were six months to one year old, most of the activities were led by their parents and teachers. From the adults, they heard poems, stories, and musical stories, delivered through singing or along with a musical instrument. In addition, they were assisted in the development of both locomotor and non-locomotor skills. For example, they would hear their parents and teachers singing in high and low pitch while being bounced to the rhythms. Finally, they would, again with the help of their parents and teachers, play a percussion instrument designed for the small hands of infants.

When the children reached one to two years of age, the skills acquired during the earlier stage were still practiced, but the emphasis of the activities was geared toward listening and movement development. During this period, the children would watch their parents and teachers demonstrate how to move to a pitch and then

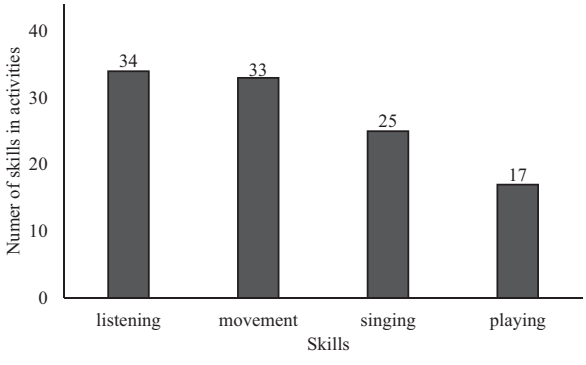

Figure 1 Musical skills developed in the classes observed

imitate. They would also move to music on their own. Last, they were encouraged to practice pronouncing words in lyrics and singing along with their parents and teachers to promote their articulatory skills, in line with early childhood speech development theories.

The activities during the last period of two to three years of age involved encouraging the children to do all musical activities by themselves although the assistance of their parents and teachers was still permitted. Sometimes, the former would lead the latter in moving, singing, or playing a percussion instrument when they had acquired or mastered such skills (Table 1).

The children's development described thus far coincided with development stages in early childhood, proceeding from listening (auditory skills) to movement (gross motor skills), singing (articulatory skills), and playing (fine motor skills). It also agreed with Piaget's cognitive development stages as the musical activities, aimed at cultivating their sensorimotor system, contributed to the stimulation of their nervous and cerebral systems. This finding was corroborated by the interview results. That is, the teachers confirmed the children's brain development based on their own research and experiences.

Analysis and Results of the Interviews with Experts

The researcher had requested one expert from different profession; a doctor who works in the department of rehabilitation medicine, faculty of medicine, at a university in the north of Thailand and the inventor of the Suandok Sound application and co-founder of CMU music therapy; next, a neuroscientist who works as a lecturer in the faculty of Early Childhood Education at a university in Bangkok and does research in the area of executive functions and neuro music for early childhood; and lastly, a music professor who is a specialist in music learning materials and children's songs and has created many learning materials such as books, music stories, and music CDs for early childhood in Thailand to provide the evaluation form pertaining to brain development from the music activities. The three experts could share their points of view in association with the contingent results of brain development from those activities. Referring to the experts' evaluation of this research, it was analyzed by identifying instances of direct enhancement of brain development by using music activities. These were based on the same answers being given by all of the experts.

In addition, instances of a direct enhancement of brain development through music activities were identified, but this time based on 2 out of 3 experts having the same answers. Moreover, it was demonstrated that out of the 44 activities, those frequently focused on brain development through memory accounted for 84 percent, or 37 from 44 activities, with 32 direct effects and 5 indirect effects to memory, language accounted for 31 activities, thinking for 26 activities and emotion for 23, with most of the effects (13 out of 23) becoming indirect. There are only two activities that affect all (memory, language, thinking, and emotion) as a role play in music story, and another playing with word order in a song. The findings were classified into direct and indirect, as in Figure 2.

Musical Activity Model to Enhance Brain Development in Children from Birth to Three Years of Age

The musical activity model was developed based on an extensive review of the literature as well as the findings from the class observation and interviews with the teachers and experts. It was also delineated in line with Steiner's model and the CIPPA model. Finally, the musical activity model was validated by seven experts, including two doctors, three neuroscientists, and two music professors, before the final lesson plan and activities were devised.

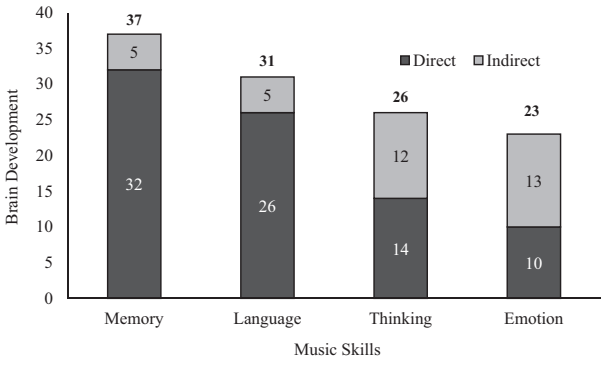

Figure 2 Direct and indirect enhancement of brain development through music activities

Table 1 Examples of activities during different age periods

Activities	6 m–1 y	1–2 y	2–3 y
Listening, movement, singing, and playing a percussion instrument	Listening to poems, stories, and musical stories; developing locomotor and non-locomotor skills; singing in high and low pitch; bouncing to rhythms	Watching; imitating; moving on one's own; pronouncing words and developing articulatory skills	Doing activities on one's own; leading parents and teachers after acquiring moving, singing, and musical instrument skills

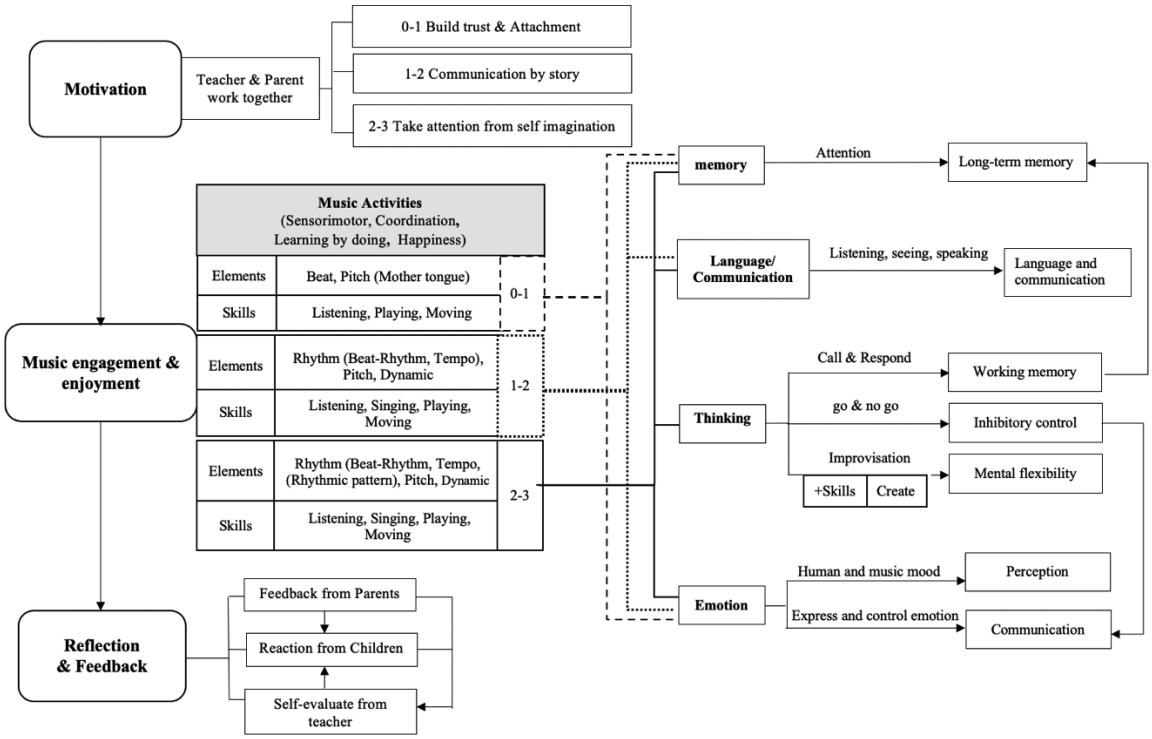

Figure 3 Music activities model to enhance brain development in children from birth to three years

From the figure, the model is split into three different stages listed below:

Stage I: Motivation

This stage was created to motivate learners to take part in music activities. Teachers played a critical role in motivation by providing companionship, communication, management of classes, and immediate problem-solving skills. Furthermore, teachers should have the creativity to design engaging activities and the ability to utilize musical mediators and provide a safe learning environment in the classrooms. In addition, teachers must collaborate with parents to understand the teaching direction and tone.

Motivation methods for each age range are as follows:

Birth to one year old: children should be motivated by building trust between parents and children to rely on each other, which helped the learning process and brain development flow smoothly.

One to two years old: children's communication started to be more coherent, so adults could motivate them by using music activities to create a story of which children would like to be a part.

Two to three years old: children could think on their own and be themselves. They should be motivated by the activities that enabled them to imagine stories creatively and build their attention to learning.

Stage II: Music engagement & enjoyment

During this stage, the activities were performed by using all of the senses at the same time. This enabled children to carry out the activity by themselves happily. Most importantly, the activities incorporated music elements and skills that were tailored to different age groups from simple ones for infants, such as beat pulses, to more complex ones, such as steady beats, to even more challenging ones, such as alternating fast and slow beats, varied tempos, short and long sounds, and duration and rhythmic patterns.

Birth to one year old: Music elements of beat and pitch were used in the activities that resembled listening to the mother singing a lullaby combined with playing and movement. The brain's development in memory was emphasized through the activities that stimulated children to repeat them. Also, brain development through emotion was driven by aspects such as perception, communication, expression, and inhibitory control of emotions.

One to two years old: the songs encompassing the music elements of rhythm (beat-rhythm, tempo), pitch, and dynamic should be used during the activities. These activities focused on listening, playing, and movement. Apart from brain development for memory and emotion, language and communication should also be emphasized through this stage. Collaborative functions of listening, sight, and speaking and focusing on pitch and rhythm's music elements are also beneficial at this stage.

Two to three years old: the music that should be employed for this age group focuses on the music elements of rhythm (beat-rhythm, tempo, rhythmic pattern). Pitch and dynamics should also be used in the activities so that children can use every skill, i.e., listening, singing, playing and movement to build their attention and develop the brain in memory and language.

Stage III: Reflection & feedback

During this stage of the activity, evaluation is employed using three key indicators. These have been classified as:

- Students' reflection on music activities by reaction or interaction.
- Parents' feedback from the observation of children's development.
- Teachers' evaluation of instruction method and design of activities and feedback from students and parents.

It is worth emphasizing that in Steiner's model and the CIPPA model, parents constitute an integral component of most, if not all, music activities for the children, as shown in Table 2.

The musical activity model described above can be adapted to design a wide array of activities for different age groups and desired learning goals, as shown in Table 3.

Based on the musical activity model to enhance brain development in very young children from birth to three years of age, the sample activity above was developed to stimulate brain development through three stages: (1) motivation; (2) music engagement and enjoyment; and (3) reflection and feedback. To illustrate, for the age period of birth to one year old, the first stage involved collaboration between the teachers and parents, which coincided with Erikson's psychosocial development hypothesis postulating the ability of very young children from birth to three years of age to build an emotional foundation through trust in their surrounding and later confidence in themselves through autonomous learning and action processes (Malone et al., 2016). In this stage, participation in the creation of music activities, such as the composition of musical tales, the selection of animal types to be included in the musical tales, and the storylines of the musical tales, was also promoted, especially among those aged two to three years. The second stage comprised several music activities to stimulate memory in very young children aged 0 to three years with appropriate adaptation of the activities based on the content in the model, such as those aimed at teaching beat and pitch elements and developing listening, playing, and movement skills. In the last stage, reflection and feedback, the teachers summarized the goals and procedures of the activities implemented and elicited parental feedback to supplement their classroom observation and aid in their self-evaluation. As reported in the literature and the present findings confirm, the children's development between one to two years of age tends to focus more on language and communication. A great deal of research demonstrates that language can be broken down into the musical elements of rhythms and pitch, especially in tonal languages (Kraus, 2015b; Nan et al., 2018; Sittiprapaporn, 2020). In addition, the integration of activities aimed at the development of skills relating to

Table 2 The relationship between 3 Models

Stages and activities	Parents	Stiner model*				CIPPA model**				
		T	S	C	X	C	I	P1	P2	A
Motivation										
0–1build trust & attachment	✓	✓	✓		✓	✓	✓	✓	✓	
1–2 communication by story	✓	✓	✓		✓	✓	✓	✓	✓	
2–3 take attention from self imagination	✓	✓	✓		✓	✓	✓	✓	✓	
Music engagement & enjoyment										
Music activities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Effect of brain development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reflection & feedback										
Feedback from parents	✓	✓	✓	✓	✓					
Reaction from children		✓	✓							
Self-evaluation		✓		✓	✓					

Note: *Stiner model: T = teacher, S = student, C = content, X = context.
**CIPPA model: C = Construction of knowledge, I = Interaction, P1 = Process Learning, P2 = Physical participation, A = Application.

rhythms and pitch with those promoting such sensory experiences as listening, seeing, and speaking can help stimulate the brain neural networks (Kraus et al., 2014; Plitakul, 2020). Finally, thinking and problem-solving abilities can be best developed during the age of two to three years (John, 2020; Malloch & Trevarthen, 2018).

Table 3 The example of music activities from the model

Age level & Content of activities	Stages		
	1. Motivation	2. Music engagement & Enjoyment	3. Reflection & Feedback
0–1 year old Musical Elements beat, pitch Skills listening, movement, playing Brian development Memory	- Teacher furnishes classroom with the star decorations and plays the piano in the Twinkle Twinkle Little Star song to create relevant contexts, and places the Shakers for children in the middle of the room. - Parents encourage children to hold and shake the Shakers along with the song.	- Sing the hello song together and hold children's limbs to move along with the beat. - Teacher sings Twinkle Twinkle Little Star song while parents hold children on lap swaying from side to side along with a steady beat. - Teacher and parents sing together in Twinkle Twinkle Little Star song and let children and parents stare into each other's eyes and move in their favorite gestures, e.g., cradle hold in breastfeeding gesture or face-to-face hold under children's arms during the course of singing. Then, parent changes to stand and walk when holding children along with the song rhythm. - Separate the movement between the song sentence A and B, e.g., hold children to walk for sentence A but in sentence B, stand and then face-to-face hold and move children's limbs up and down along with the song and when the lyric returns to sentence A, switch to hold children to walk along with the beat.	- Review the sequence of activities. Then, explain the object of class and effect of memory with parents and get feedback. - Teacher sings and does movements in the Goodbye song with class. Then, self-evaluate from children reaction in whole class and feedback from parents.
1–2 years old Musical Elements rhythms, pitch, dynamics Skills listening, movement, playing, singing Brian development Memory, language and communication	- The teacher talked about farms with the children, and the parents encouraged them to answer questions or pick their most favorite animal picture. Then teacher linked the activity to the Old MacDonald Had a Farm story.	- The teacher introduced the Old MacDonald character to the children and then sang the Hello song and moved to the song to greet the Old MacDonald and animal characters in the story. The teacher also encouraged the children to repeat the names of the animals or mimic the sounds they made. - The teacher told the children that they would together go to visit the family of each of the animals. Then the teacher showed animal pictures in three different sizes, i.e. the biggest picture, representing the father, the medium-sized picture, representing the mother, and the smallest picture, representing the baby. Then, the teacher made the animal sounds in the 5th interval using the word *moo*(C), *moo*(G), and *moo*(C), and let the children and their parents repeat. The teacher would sometimes add some small, middle, and big cow-like movements to reflect or highlight the pitch being used. This activity focused on enabling the children to pronounce more words and use a wider range of pitch. It would also enhance the children's language and communication as they memorized words while coordinating their sensory experiences. - The teacher gave the children a percussion instrument to practice following the rhythm of the Old MacDonald Had a Farm song or playing only the part "EIEIO".	- The teacher reviewed the sequence of the activities. The teacher then summarized the objectives of the activities and their effects on the children's memory and language development to the parents as well as provided feedback on their participation. - The teacher sang the Goodbye song and danced along. The teacher also encouraged the parents to evaluate the outcomes of their children's participation in the activities.

Table 3 Continued

2–3 years old Music Elements- rhythmic patterns, pitch Skills- listening, movement, playing, singing, improvisation Brian development Memory and thinking	- The teacher set the class theme, such as 'travel'. For the travel theme, the teacher asked the children to choose the destination and how to reach the destination, such as walking to the jungle.	- The teacher asked the children to help design movements for the Hello song. Then the class sang the song together. During the singing activity, the teacher changed the words in the lyrics in line with the children's movement, such as waves, claps, or taps. - Let's go travel. The teacher and children sang and danced while walking to the jungle. During the activity, the teacher sometimes made up some situations to make the children walk, stop, and proceed again. For instance, the teacher sang 'the storm yesterday caused a branch to fall down and block the path' and asked the children to solve the problem. Alternatively, the teacher could request the children to help a lost baby monkey find its parents by repeating words the teacher had produced in different pitch ranges or rhythms, or improvising their own words, pitch ranges, or rhythms. In the meantime, the teacher constantly checked the children's level of interest or attention in the activity. - After reaching the destination, the teacher changed to an activity for another musical element by telling the children to clap and tap the drum using the rhyme 'feed the bird, ti ti ti'.	- The teacher reviewed the sequence of the activities. The teacher then summarized the objectives of the activities and their effects on the children's memory and language development to the parents as well as provided feedback on their participation. - The teacher sang the Goodbye song and danced along. The teacher also encouraged the parents to evaluate the outcomes of their children's participation in the activities.

The results from the teacher interviews and expert opinions agreed that the musical activity model had a direct impact on the children's memory (Techaaphnchai & Raktapajit, 2021). They believed that listening and moving to the beats of the songs with the aid of parents would enhance cognitive development. This is in line with Piaget's cognitive development theory stating that the first three years constitute the sensorimotor stage, where intelligence is mainly developed through and hence expressed in the form of movement as very young children from birth to three years of age learn from direct experience through sensory stimuli. Clearly, the music model proposed in the present research is likely to promote cognitive development since it combines various sensorimotor activities, including listening, singing, playing, moving, observation, mimicry, and repetition, which not only link existing to new experiences but also contribute to physical, neural, and cerebral development from large and small muscle movements (Piaget & Inhelder, 1972).

Another reason in support of the role of music activities in brain development is their direct impact on emotional and social development as they are circle time activities in which children interact with other individuals while enjoying the music. As a great deal of research demonstrates, lullabies are the most significant precursor to emotional development (Corbeil et al., 2013; Nakata & Trehub, 2004; Trehub & Nakata, 2002).

It is clear from the findings that in addition to the teachers and children, the parents played a vital role in all the stages from motivation to reflection and feedback. This finding is in agreement with Ngampornsukswadi et al. (2012), which reported that parental involvement in the learning process of young children would better the quality of learning and intensify the extent of behavioral observation, thereby maximizing learning outcomes both at home and in school.

Finally, it is worth noting that the present study affords unique insight into how music activities help enhance brain development in very young children aged 0 to three years, unlike most previous research, such as Steiner's model, the CIPPA model, and the musical experiential model, all of which focus on children four to five years of age (Chaiakaraphong et al., 2021).

Conclusion and Recommendations

This research aimed to develop a conceptual model for music activities that enhances brain development for birth-to-three year old children in Thailand. Before proceeding with this model, the teacher should understand stage II of the method: music engagement & enjoyment for creating activities which are proper for children. The teacher should understand the music elements and skills that suit each age and also the brain development needs for the relevant age, as these are different for each age group. When teachers understand the ideal music teaching elements for each age group and the purpose of the teaching in relation to brain development, they can create

the multiple activities for the children all focused on their specific needs. However, the result has shown that the brain will be most affected by activities like role play in music stories and playing with song word order.

After creating the activities, a teacher can use the music activities model by working with parents to start with stage I: Motivation for children to join the activities. However, it is important to understand the different motivations for each age. Stage III: reflection & feedback, is also important as this will enable teachers to evaluate themselves and the effectiveness of the activities using children's reactions or interaction in class and also the feedback from parents. Parents had to participate in all the classroom activities with the children from the first stage and repeat them with the children after class to sustain their development.

The musical activity model to enhance brain development in young children presented in this study will benefit those who teach children from birth to three years of age, including parents and teachers. First, it can be used to provide guidelines for the design of musical activities to promote brain development through practice in different skills and exposure to different sensory experiences. It can also serve as a foundation based on which musical activities for older children can be devised. Finally and most importantly, should musical activities be proven to be genuinely efficient in enhancing brain development and thus incorporated into a curriculum, they will play a more vital role in childhood education in the future.

Conflict of Interest

The author declares that there is no conflict of interest.

References

Brandl, M. L. (2011). *Neurological research and its implications for a kodaly-based elementary general music program* [Master's thesis, Silver Lake College].

Chaiakaraphong, N., Pichayakul, T., Klangphahol, K., & Chinnapong, P. (2021). Development of music experiential model to enhance executive functions of early childhood. *Kasetsart Journal of Social Sciences*, *42*(3), 564–570. https://doi.org/10.34044/j.kjss.2021.42.3.17

Cirelli, K. L., Jurewicz, B. Z., & Trehub, E. S. (2019). Effects of maternal singing style on mother–infant arousal and behavior. *Journal of Cognitive Neuroscience*, *32*(7), 1213–1220. https://doi.org/10.1162/jocn_a_01402

Collins, A. (2015). *How music helps your child's brain grow*. https://musiceducationworks.wordpress.com/2015/11/20/how-music-helps-your-childs-brain-grow/?blogsub=confirming#blog_subscription-4

Collins, A. (2017). How lullabies promote positive emotional connection between parent and child. https://www.abc.net.au/radio/melbourne/programs/ afternoons/anita-collins/8664402

Corbeil, M., Trehub, E. S., & Peretz, I. (2013*)*. Speech *vs.* singing: Infants choose happier sounds. *Frontiers in Psychology*, 1–11. https://doi.org/10.3389/fpsyg.2013.00372

Jantzen, M. G., Large, E. W., & Magne, C. (2016). Editorial: Overlap of neural systems for processing language and music. *Frontiers in Psychology*, *7*, 876. *Music in early childhood and consciousness: A Philosophical analysis of intersections* [Doctoral dissertation]. University of Toronto.

Khammani, T., Phanthalert, C., Pramounsinchai, P. (2005). *CIPPA Model*. Institute of Academic Development.

Korsakova-Kreyn, M. (2019). Language of music and its psychophysical foundations. *Sovremennye Tehnologii V Medicine [Modern Technologies in Medicine]*, *11*(1), 40–45. https://doi.org/10.13140/RG.2.2.16367.89763

Kraus, N., Slater, J., Thompson, E. C., Hornickel, J., Strait, D. L., Nicol, T., & White-Schwoch, T. (2018). Music enrichment programs improve the neural encoding of speech in at-risk children. *The journal of Neuroscience*, *34*(36), 11913–11918. https://doi.org/10.1523/JNEUROSCI.1881-14.2014

Kraus, N. (2015a). *Breaking the wall to neuroeducation @ falling walls conference 2015 SD*. https://www.youtube.com/watch?v=YYw17xCTPTI

Kraus, N. (2015b). *Rhythm in the brain spotlight on reading*. https://brainvolts. northwestern.edu/music/

Kubota, K. (2016). *A genius brain can be created from newborn* (S. Selahorm, Trans.). IDC Premoer. (Original work published 2009).

Kubota, K., & Kubota, K. (2018). *A genius brain can be created from toddler.* (N. Jungma non, Trans.). Sand Block Book. (Original work published 2015).

Malloch, S., & Trevarthen, C. (2018). The human nature of music. *Frontiers in Psychology*, *9*, 1680. https://doi.org/10.3389/fpsyg.2018.01680

Malone, J. C., Liu, S. R., Vaillant, G. E., Rentz, D. M., & Waldinger, R. J. (2016). Midlife Eriksonian psychosocial development: Setting the stage for late-life cognitive and emotional health. *Developmental Psychology*, *52*(3), 496–508. https://doi.org/10.1037/a0039875

Mehr, A. S. (2017). *Social functions of music in infancy* [Unpublished doctoral dissertation]. Harvard Graduate School of Education.p

Nakata, T., & Trehub, E. S. (2004). Infants' responsiveness to maternal speech and singing. *Infant Behavior and Development*, *27*(4), 455–464. https://doi.org/10.1016/j.infbeh.2004.03.002

Ngampornsukswadi, S., Chai-aroon, T., Phlainoi, S., & Makkasman, W. (2012). Parenting roles promotion model for participation in early childhood learning development. *Kasetsart Journal of Social Sciences*, *33*(3), 387–396. https://so04.tci-thaijo.org/index.php/kjss/article/view/246852

Partanen, E., Kujala, T., Tervaniemi, M., & Huotilainen, M. (2013). Prenatal music exposure induces long-term neural effect. *PLoS One*, *8*(10), e78946. https://doi.org/10.1371/journal.pone.0078946

Piaget, J. (1952). *The origin of intelligence in children.* International Universities Press.

Piaget, J., & Inhelder, B. (1972). *The psychology of the child*. Basic Book.

Plantinga, J., & Trainor, L. J. (2005). Memory for melody: Infants use a relative pitch code. *Cognition*, 98, 1–11. https://doi.org/10.1016/j.cognition.2004.09.008

Plitakul, P. (2020, March 20). Interview [Tape recording]. Music Educator.

Restrack, R. (2006). *Mozart's brain and the Figater pilot.* (Kitavipoo,Trans.). Good morning. (Original work puclished 2001).

Saffran, J. R., Loman, M. M., & Robertson, R. R. W. (2000). Infant memory for musical experiences. *Cognition*, *77*, B15–B23. https://doi.org/10.1016/S0010-0277(00)00095-0

Skeie, O. G. (2018). *A piano lesson for life -changing the brain through music (TEDxOslo)*. https://www.youtube.com/watch?v=80H4g8F6wm8

Steiner, E. (1988). *Methodology of theory building*. Educology Research Associates.

Suttachitt, N. (2018). *Music education principal and matter*. Chula Press.

Techaaphnchai, N., & Raktapajit, S. (2021). Pattern of music activities from birth to three years old in Bangkok to enhance brain development and memory. *Princess Galyani Vadhana Institute of Music Interdisciplinary Music and Innovation Graduate Symposium*, 8–34.

Trainor, L. J., Wu, L., & Tsang, C. D. (2004). Long-term memory for music: Infants remember tempo and timbre. *Developmental Science*, *7*(3), 289–296. https://doi.org/10.1111/j.1467-7687.2004.00348.x

Trehub, E. S., & Nakata, T. (2002). Emotion and music in infancy [Special section]. *Musicae Scientiae*, *5*(1), 37–61. https://doi.org/10.1177/10298649020050S103

Trehub, E. S., Plantinga, J., & Brcic, J. (2009). Infants detect cross-modal cues to identity in speech and singing. *Annals of the New York Academy of Sciences*, *1169*(1), 508–511. https://doi.org/10.1111/j.1749-6632.2009.04851.x

Trehub, E. S. (2015). *Infant musicality, The Oxford handbook of music psychology* (2nd ed.). Oxford University Press.

Trollinger, L. V. (2010). The brain in singing and language. *General Music Today*, *23*(2), 20–23. https://doi.org/10.1177/1048371309353878

Urwongse, K. (2019). Focus group discussion: Effective qualitative data collection technique. *STOU Education Journal*, *12*(1), 17–30. https://so05.tci-thaijo.org/index.php/edjour_stou/article/view/182081

Nan, Y., Liu, L., Geiser, E., Shu, H., Gong, C, C., Dong, Q., Gabrieli, D, J., & Desimone, R. (2018). Piano training enhances the neural processing of pitch and improves perception in Mandarin-speaking children. *PNAS*, *115*(28), E6630–E6639. https://doi.org/10.1073/pnas.18084112115

Volkova, A., Trehub, E. S., & Schellenberg, E. G. (2006). Infants' memory for musical performances. *Developmental Science*, *9*(6), 583–589. https://doi.org/10.1111/j.1467-7687.2006.00536.x

Zentner, M., & Eerola, T. (2010). Rhythmic engagement with music in infancy. *PNAS*, *107*(13), 5768–5773. https://doi.org/10.1073/pnas.1000121107