El desarrollo de la lógica en educación de la Primera Infancia

To begin emphasizing mathematics in infants, toddlers and preschoolers we need to begin to look at the construction of mathematical concepts the same way that we look at literacy development - as emergent (Geist & Geist, 2008; Geist, 2008). The idea that literacy learning begins at birth is widely accepted in early childhood. Literacy programs are mandated by State and Federal agencies in Head Start programs.

Children, from the day that they are born, are mathematicians (Butterworth, 2005; D'Arcangelo, 2001). They are constructing knowledge constantly as they interact mentally, physically, and socially with their environment and with others (Kamii, Joseph, & Livingston, 2003). Young children age Birth - 5 may not be able to add or subtract using formal mathematics the way an older child or adult understands it, but the relationships that they are making and their interaction with a stimulating environment leads them to construct a foundation and framework for what will eventually be formal mathematical concepts.

Math, like reading, can be treated as a developmentally interactive process that follows a generally standard sequence of gradual development beginning at birth. This development can be nurtured in early education programs. This is why it is important train parents and teachers that work with children under the age of 5 to recognize and promote these mathematical concepts (Gresham, 2007; Jacobson, 2007). One of the best and most effective tools that we have found to do this, is by using music and musical activities (Geist & Geist, In Press).

Musical Elements
Math and music share similar inherent characteristics and structure and appear to be related in the brain from very early in life (Weinberger, 1998). We know, for instance, that music contains numerous mathematical constructs from within its basic structure. Musical elements such as steady beat, rhythm, and melody possess inherent mathematical principles such as spatial properties, sequencing, counting, patterning, and one-to-one correspondence. Music also seems to be related to very primal parts of the brain (Holden, 2001). Our bodies cannot help but react physiologically to musical input (Hasan & Thaut, 2004; Thaut & Kenyon, 2003). This implies that even the youngest of children have the potential to inherently respond to music and the mathematical constructs it contains. Direct musical instruction such as piano lessons is not developmentally appropriate for infants, toddlers and preschoolers. However, there are many other ways that these children can be exposed to and interact with music in a manner that can stimulate the brain.

Many commercially available music compilations for young children include “Brain Music”, which is supposed to make infants, toddlers or preschoolers smarter, have suddenly appeared on store shelves (Church, 2002). While not a harmful practice, as of yet, there is little conclusive data to support the positive outcomes of such practices based on the Mozart Effect (Holden, 2003). There is also evidence that music can support emergent mathematics, such as early patterning experiences and one-to-one correspondence, in young children even from birth to age 5 (Burack, 2005; Church, 2000; Du Sautoy, 2004; Fagan, 2000).

The MathSTAAR project (mathstaar.org, 2008) uses music to support, enhance and encourage mathematical development in children under the age of five. We found through journal review and interviews of Head Start Teachers that the teachers feel more comfortable with math lessons that incorporate music. We also found that children responded more strongly to and were more motivated by the math activities that included music. During free playtime children could be observed singing the songs and making patterns from the songs that were introduced days earlier. For example, a university student reported that two days after a mathematics activity that included the song “BINGO” (which contains a pretty elaborate patterning activity and even some
counting), two children were spontaneously singing “BINGO” and counting their claps while playing on the playground (Geist & Geist, 2008).

Using the universal nature and the many different cultural variations of music, it would be logical to utilize musical elements as support for learning mathematics for promoting infants, toddlers and preschoolers to construct emergent mathematics. Teachers and parents may already be using some of the elements of music in their everyday interactions with children. For example, elements of rhythm are one of the ways to make predictable books, predictable. Children can anticipate the rhythmic pattern and that helps them to remember the words to a familiar story. Another example is patterning activities. Preschools and Kindergartens are rife with manipulatives to support interaction with objects and patterning. However the very first patterning activity that a child encounters is musical. When a parent comforts their crying child they may pat, rock or bounce their child using a steady beat or a rhythmic pattern. They may even sing them a simple song while they do this. A steady beat, rhythmic pattern and melody are prime examples of patterning activities.

**Steady Beat**

Steady beat is what you feel or have a physical response to when you hear music. This may be what you are doing when you tap your toe while listening to music. You are tapping the steady beat. The steady beat is repetitive and evenly spaced. Providing a steady beat as part of your teaching for young children can support the construction of “one” and the development of patterns.

Steady beat activities such as clapping or marching help the child understand numerical relationships such as one-to-one correspondence and even “more”. Toddlers may not know number but they understand “more”. For example, if you clap once and then you say, “Can you clap more than I clapped?” a toddler will most likely clap more than once.

Also, keeping a steady beat while teaching adds a visual and auditory structure to the experience by promoting prolonged and higher quality attention to a task. Providing a steady beat is essential when singing songs or encouraging children to participate in any musical experience.
Rhythm

Rhythm is not always the same as the steady beat. An illustration of this using “Old MacDonald Had a Farm” is given in Insert 2. The rhythm varies, while the steady beat is constant, which allows a child to notice more complex and distinct patterns. They also can make one-to-one correspondence relationships between the rhythm, beat and the words to the song. Rhythm can help children to develop patterning abilities. They can repeat, predict and extend rhythmic patterns easily. For example in “Old MacDonald Had A Farm” the teacher can sing “With a moo moo here” and the child can repeat and even extend the pattern of the song by singing “and a moo moo there” with little effort.

Melody

Look at the melody of our familiar song “Old MacDonald Had a Farm”. This time we will focus on the repetitive pattern “EIEIO”. When sung, you may notice that you sing from a higher note to a lower note. EI are repeated on a higher note. The next EI are repeated on a lower note, and O is sung on even a lower note. This moving from one note to another is the melody of the song in other words the tune.

<table>
<thead>
<tr>
<th>EI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ei</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>-</td>
</tr>
</tbody>
</table>

Putting it together

With a basic understanding of steady beat, rhythm and melody, teachers and parents can incorporate these musical elements to their ‘normal’ teaching strategies such as promoting emergent mathematics. Children can create, reproduce and extend patterns and explore one-to-one correspondence using steady beat, rhythm and melody. These three components can be used alone or in combination to create simple and complex patterns for children to explore and interact with in a developmentally appropriate manner.

With children under the age of 5, our goal is not to teach formal mathematics or to teach children to memorize their numbers or “math facts”. The goal is to provide
Providing a steady pulse or beat during an academic lesson has been shown to promote increased and active engagement when working with children (Geist and Geist, 2008). However, sometimes keeping an effective beat is not always as easy as it seems. If a teacher is not responsive to the children’s needs in terms of beat, rhythm and tempo, a steady beat can become ineffective and possibly a ‘distractible moment’ if not used properly.

Once a teacher gets accustomed to leading a musical experience, it is important to check in on engagement. If students are beginning to look away or talk to each other, this is a clear sign that the steady beat isn’t as effective for active engagement as it was at the beginning of the lesson. The children have become accustomed to the steady beat, tempo, and dynamics and it is not keeping their attention as well as it did at the beginning of the song. Here is a list of ways you can change the song to get attention:

- Chant/Sing softer but overstate the consonants
- Chant/Sing louder making the vowels longer
- Speed up the tempo
- Slow down the tempo
- A combination (e.g. softer/ fast or louder/slower)

Anyone can use music to promote learning in the classroom. Practicing some of these basic strategies will yield instant success.

References

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días 27, 28 y 29 de Marzo de 2009 en Guanajuato (México)


Geist, E., & Geist, K. (2008). Do re mi, 1-2-3; that's how easy math can be. *Young Children, 63*(2), 20.


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Do Re Mi, 1,2,3 – That’s How Easy Math Can Be: Using Music To Support Emergent
Mathematics

In press with Young Children for March 2008

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Cluster Theme - Integrating the Curriculum in the Early Years and Beyond
This article examines the relationship between music and mathematics in young children. The concept of emergent mathematics holds that children can begin to learn and interact with mathematics from a very early age, even as young as birth. One of the first venues for this interaction is music. Music is filled with patterning and one-to-one correspondence interactions that can stimulate the child’s mathematical brain. This article also gives examples of what parents and teachers can do to help promote the music and math link.
Many of us may have heard of the ‘Mozart Effect,’ a term that has been coined in response to a study which indicated that listening to music composed by Mozart enhanced the spatial-temporal reasoning of preschoolers (Rauscher and Shaw 1998). In Don Campbell’s book entitled *The Mozart Effect* (Campbell 2001), he described the phenomena that arose from this and other studies like it indicating that students, who listen to the music composed by Wolfgang Amadeus Mozart, might be able to perform better on academic tasks.

Due in part to this ‘music cure’, in the late 1990s, a person might walk into a school in the United States and hear Mozart’s concertos or symphonies playing in the hallways, or walk into a music store and find the Mozart collections sold out (Holden 1999; Levy and Rogers 1999; Shaw 2004). However, as of yet, there is little conclusive data to support the existence of the Mozart Effect for children (Holden 2003). With society teased by the prospect of “smarter babies”, many commercially available music compilations for young children that include “Brain Music” which is supposed to make your infant, toddler or preschooler smarter, have suddenly appeared on store shelves (Church 2000).

A direct link between passively listening to music and improvement in spatial reasoning or mathematics tasks may not exist, however there is other convincing evidence that indicates that interacting musically by singing or learning to play an instrument can improve the brain’s development (Peterson and Thaut 2007). There is also evidence that music can support emergent
mathematics, such as early patterning experiences and one-to-one correspondence, in young children even from birth (Church 2000; Du Sautoy 2004; Frank 1996, 1997; Mendlesohn 1990; Motluk 1997; Perret 2006).

Does a child need to have musical instruction such as piano lessons to get the benefit of improved mathematical ability and understanding or can simply interacting with music stimulate development of mathematical understanding? For infants, toddlers and preschoolers private music instruction on an instrument is not always developmentally appropriate. However, there are many other ways that these children can be exposed to and interact with music in a manner that can stimulate the brain.

**Music and the Brain**

Research suggests that math and music may be related in the brain from very early in life (Burack 2005; Begley 2000; Weinberger 1998). We know, for instance, that music contains numerous mathematical constructs from within its basic structure. Musical elements such as steady beat, rhythm, tempo, volume, melody, and harmony, possess inherent mathematical principals such as spatial properties, sequencing, counting, patterning and one-to-one correspondence. Also music seems to be related to very primal parts of the brain (Holden 1999). Our bodies cannot help but react physiologically to musical input (Hasan and Thaut 2004; Thaut and Kenyon 2003). This indicates that even very young
children could inherently respond to music and the mathematical constructs it contains.

**Musical Elements**

If math and music share similar inherent characteristics, how convenient and helpful it would be to utilize musical elements as support for learning mathematics when teaching infants, toddlers, and preschoolers. As a teacher, you may already be using some of the elements of music and mathematics in your classroom. For example, elements of rhythm are one of the ways to make predictable books, predictable. Children can anticipate the rhythmic pattern and that helps them to remember the words to a familiar story. This type of structure to an emergent literacy activity can also be applied to emergent mathematics. The challenge is to recognize the musical elements and the effect they can have on the development of emergent mathematics. Let’s look at some basic elements of music and how they can relate to mathematics.

**Steady Beat**

Beat or pulse, for purposes of this article, we will call it ‘steady beat,’ is what you feel or have a physical response to when you hear music. This may be what you are doing when you tap your toe while listening to music. You are tapping the steady beat. The steady beat is repetitive and evenly spaced.
Providing a steady beat as part of your teaching for young children can support the construction of “one” and the development of patterns (Insert 1).

Steady beat activities such as clapping or marching help the child understand numerical relationships such as “more” and one-to-one correspondence. Toddlers may not know number but they understand “more”. For example, if you clap once and then you say, “Can you clap more than I clapped?” a toddler will most likely clap more than once.

Also, keeping a steady beat while teaching adds a visual and auditory structure to the experience by promoting prolonged and higher quality attention to a task. Providing a steady beat is essential when singing songs or encouraging children to participate in any musical experience. Thaut and colleagues at the Center for Research in NeuroRehabilitation at Colorado State University have been studying the effects of an assessed beat technique, Rhythmic Auditory Stimulation, for patients who have been diagnosed with mild to moderate Parkinson’s Disease who have uneven gait. Results indicate that this technique is effective in helping patients walk with an even gait (Hasan and Thaut 2004; Thaut and Kenyon 2003). Tips on providing a steady pulse experience for children is are described in Insert 2.

Rhythm

Rhythm is not always the same as the steady beat. An illustration of this using “Old MacDonald Had a Farm” is given in Insert 3. The rhythm varies, while
the steady beat is constant, which allows a child to notice more complex and distinct patterns. They also can make one-to-one correspondence relationships between the rhythm, beat and the words to the song. The words represent the rhythm and the clapping represents the beat. Keeping them synchronized, clapping and singing together creates a natural one-to-one correspondence experience.

Rhythm also helps children to develop patterning abilities. They can repeat, predict and extend rhythmic patterns easily and even rhythmic pattern. For example in “Old MacDonald Had A Farm” the teacher can sing “With a moo moo here” and the child can repeat and even extend the pattern of the song by singing “and a moo moo there” with little effort.

**Melody**

Now let’s discuss the melody of our familiar song “Old MacDonald Had a Farm”. This time we will focus on the repetitive pattern “EIEIO”. When sung, you may notice that you sing from a higher note to a lower note. EI are repeated on a higher note. The next EI are repeated on a lower note, and O is sung on even a lower note. This moving from one note to another is the melody of the song in other words the tune.
With a basic understanding of steady beat, rhythm and melody, teachers and parents can incorporate these musical elements to their ‘normal’ teaching strategies such as promoting emergent mathematics. Children can create, reproduce and extend patterns and explore one-to-one correspondence using steady beat, rhythm and melody. These three components can be used alone or in combination to create simple and complex patterns for children to explore and interact with in a developmentally appropriate manner.

**Tempo, Dynamics, Timbre, and Style**

Other musical elements that are incorporated into music are tempo, dynamics, timbre, and style. Tempo refers to the speed, dynamics refers to the volume and timbre is another word for the quality of the sound. For example when listening to someone playing a tambourine, a person might say that the timbre has a “shrill sound” when played fast. Descriptor words such as shrill or dry, are usually describing the timbre or tone quality of the music.

The style of a song usually refers to an established genre of music such as, Jazz, Country, Rock n Roll, Blues, Spiritual, American Folk, etc. Children may enjoy listening to different styles. Older children can even begin comparing different styles of music. Can you describe what makes Rock and Roll and
Country music different? Is it the steady beat? The rhythm? The melody? Is there a specific pattern in the rhythm that makes the style distinctive? What about the timbre? Think about these elements that next time you listen to your favorite music (Insert 4).

Now that you are recognizing different elements in music, let’s see how these elements apply when using music to interact with children. Furthermore, how can these elements of music promote mathematical thinking?

**Music Experiences to Promote Emergent Mathematics**

5-month-old Julie sits in her mother’s lap as her mother sings to her “Twinkle Twinkle Little Star”. Julie stares at her mother’s face as she sings. Her mother finishes the song and Julie smiles broadly.

As we see with Julie, music is often one of the first communicative venues for children. It is also one of the child’s first interactions with mathematics. Julie’s mother probably sang her a song with a very distinctive steady beat and rhythm. It has a feeling of “1 and 2” as the steady beats repeat. Julie’s mother may even bounce Julie on her knee in time with the steady beat of the song.

Julie, now 13 months old, sits in the middle of an infant and toddler classroom. She hears a recording of Twinkle Twinkle Little Star on the stereo and moves toward some wrist jingle bells on a nearby shelf. She begins to shake the bells and march around a table keeping a regular beat
and rhythm that roughly matches the song. Occasionally she vocalizes using recognizable and unrecognizable utterances.

Julie has made a link between what she heard as an infant from her mother into action as a toddler. Julies marching and singing behavior shows evidence of patterning and one-to-one correspondence. Because researchers have found this type of reaction typical, having music as part of the preschool experience is encouraged (Frank 1996; Livingston and Fenton 1998; Perret 2006).

Parents often observe children banging cabinet doors or pulling out the pots and pans and banging them or their lids. While often distressing to adults, the child is exercising some of their newly found abilities and also demonstrating their emerging mathematical ability (Holden 1997).

Teachers can use drums with infants and toddlers. The example in Insert 6 teaches visual and auditory imitation but also supports a one-to-one correspondence relationship in the child’s mind. Other musical activities also have regular steady beats that the teacher can emphasize during movement activities such as tapping cymbals, shaking bells and marching to music just to name a few.

Even a novice or ‘untrained’ musician can use elements of steady beat, rhythm, melody, tempo, dynamics, style, and timbre when interacting with
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children. Once it is realized that these techniques can be used in the classroom
or at home, the world of learning becomes much more enjoyable and much more
effective for the parent, teacher and the child. Any activity can be made musical.
For example a child is playing with different colored blocks in a more or less
random manner. To facilitate the child recognizing and sorting by color the
teacher can chant the following phrases with a steady beat.

<table>
<thead>
<tr>
<th>RHYTHM</th>
<th>Here is a</th>
<th>Red Bowl</th>
<th>There is a</th>
<th>Blue Bowl</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEAT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>RHYTHM</td>
<td>Put the red blocks in the Red bowl and the Blue blocks in the Blue bowl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEAT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Usually phrases with 4 or 8 steady beats are most effective. Remember,
making the rhythm different from the steady beat will gain the child’s attention. If
needed, repeat the phrases for the children that need extra help and possibly in a
simpler way, like this:

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Red in</th>
<th>Red and</th>
<th>Blue in</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beat</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Remember, you can change the tempo if necessary, making it faster or
slower to fit the learning needs of the child. Also, you can add dynamic changes
to promote learning. For example, if the child has trouble matching the blue block with the blue bowl, you could chant all the other words softer and chant the BLUE louder to emphasize which bowl you want them to focus on. The dynamics give them a cue to which one they need to fix. You can also slow the tempo down right before you say BLUE to emphasize that something coming up needs to be fixed.

Timbre, the quality of the sound, can also be used to get children’s attention. You can make a different quality of sound for the concept that is giving the child trouble. Experimenting with different ways to sing the word BLUE such as making it sound like a faucet dripping, might make it fun for the child because making different sounds is always fun. The fun has real purpose, however, because this change in sound timbre brings attention to the concept that you are trying to facilitate.

Finally, you can change the style of the music. Again, changing the style can draw a child’s attention to an experience. Knowing how to sing or chant different styles might take a little practice and a bit of courage. If you aren’t familiar with different styles, spend time listening to different styles of music. Then, just for fun, take a risk and try chanting or singing in that style for your students when you are teaching. For example see if you can do the examples we gave in this article using a country style. It may be difficult and you may feel a bit silly, but it should be fun for everyone involved.
Conclusion

Research on emergent mathematics is beginning to show that even infants can interact with and understand mathematics. Music can be employed as an important tool in facilitating the construction and support of emergent mathematics (Geist 2001). Music is an experience with which even the youngest children can interact; therefore it is an exciting medium for engaging children in mathematics. The structure of musical elements such as steady beat, rhythm and melody can be used to support many different activities in the classroom. Mathematical activities such as patterning and one-to-one correspondence are especially easy to link to music.

All teachers are musicians. You don’t have to be a trained musician to use these techniques in your classroom. If you have trouble singing, then chant. Remember as Harold Hill said in “The Music Man”, singing is just sustained talking.
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INSERTS – (Note: these can be pared down to meet page requirements as needed.)

Insert 1

Steady Beat Experience

Consider the following familiar tune.

“Daisy Daisy, give me your answer, do. I’m half crazy all for the love of you. It won’t be a stylish marriage. I can’t afford a carriage. But you’ll look sweet, upon the seat, of a bicycle built for two.” (“Daisy Bell” Music and Lyrics Harry Dacre, 1892)

1) Hum, sing, or chant this song (you can even sing it in your head)

2) NOW…. See if while you’re doing it, you see your toes tapping. If so, you are tapping the steady beat.

3) If not, try tapping your toes, tapping your knees, or clapping your hands to the heartbeat of the song. Try tapping or clapping where the numbers are directly below the bolded syllable of the words in the following table. The numbers below represent the steady beat of the song.
Insert 2

Some Tips On Incorporating a Steady Beat While Teaching

1) Provide a steady beat by tapping your knees at least 4 times before giving instructions (to prepare the student for the instructions).

2) Tap the steady beat while giving the verbal instructions.

3) You can emphasize the steady beat when giving instructions. For example, consider the instruction: “Put the red block in the red bowl.” In this example the steady beat is on the bolded words.

4) Encourage students to tap their knees to a steady beat along with you while you are giving instructions set to that steady beat. For example “Wash your hands and get some snack. One, Two, Ready, Go”

5) If singing or chanting is part of an activity that you are doing, overemphasize the syllables that are stronger steady beats. For example keeping up with all the steady beats in “Down By the Bay” may be difficult, but you can emphasize the long sustained beat at the end of each line. “Down by the baaaaaaaay, where the watermelons grooooooow, back to my hooooooome, I dare not goooooo. . .”
Note: In numbers 4 and 5 children can be encouraged to recognize the difference in how steady beat is used in the two songs to create a musical pattern. The example in number 4 is much more predictable which is why it works well for focusing children’s attention on simple instructions. The example in number 5 is more complex and varied which makes it more fun to sing along with and therefore engages children’s interest even when addressing the complex mathematical aspects of the pattern.

Insert 3

Beat/Rhythm Experience

Let’s examine the familiar ‘EIEIO’ section of Old Mac Donald Had A Farm.

1) Start by tapping your feet at the same time to a steady beat.

2) Now say E I E I O. If you said a letter with each beat, that’s a good start.

3) Now try saying EIEIO and only tap on the E’s and O’s.

4) You may notice that you are saying EI on the first beat, EI on the second beat and O as the third.

5) The actual ‘E I E I O’ that you chanted is the rhythm.

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>E I</th>
<th>E I</th>
<th>O</th>
<th>-</th>
</tr>
</thead>
</table>

![Image of children holding hands]
Beat 4 in this case is felt and tapped before continuing the song. It is a rest.

Insert 4

Listen to a familiar song on the radio, CD player, Ipod, etc.

1) How easy was it to find the steady beat?
2) What kinds of tempo changes did you notice?
3) What kinds of dynamic changes did you notice?
4) Were there any interesting style changes?
5) Were there any notes or words that were emphasized more than other?
   (In other words, did the tone quality or timbre change while you were listening?)

Insert 5

Drumming Experience (Teacher and Child) Materials: 2 hand held drums with mallets to play

1) Teacher plays 1 beat on a drum and stops to wait for child to play a beat.
2) Whatever the child plays, the teacher acts as an echo.
3) If the child echoes the teacher, the teacher can continue to play one beat with the child echoing seeing if the child will create another rhythm.

4) If the child continues to imitate the one beat, the teacher then can then create a new rhythm, next step would be a rhythm with two beats. Again, the teacher will wait to see if the child imitates.

5) It is important to begin imitating the rhythm of the child if he/she creates his/her own rhythm.

6) It is also important to not underestimate the complexity of a rhythm that a child can imitate. Always, if the child does not imitate the rhythm that the teacher provides, the rhythm given may be too complex or might be boring to the child. This is where the teacher can judge whether to make it more complex or easier.
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