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About the Journal

Founded in 2013, the Journal of Teacher Action Research (ISSN: 2332-2233) is a peer-reviewed online journal indexed with EBSCO that seeks practical research that can be implemented in Pre-Kindergarten through Post-Secondary classrooms. The primary function of this journal is to provide classroom teachers and researchers a means for sharing classroom practices.

The journal accepts articles for peer-review that describe classroom practice which positively impacts student learning. We define teacher action research as teachers (at all levels) studying their practice and/or their students' learning in a methodical way in order to inform classroom practice. Articles submitted to the journal should demonstrate an action research focus with intent to improve the author's practice.

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TEACHING MATHEMATICS WITH MUSIC TO YOUNG CHILDREN AND CONNECTING FAMILIES

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Abstract This project was designed to engage children in learning mathematics through music in a pre-k classroom. The Pre-k teacher noticed that children were getting disinterested in learning mathematics but showed interest in music. In the unit on "Penguins" the teacher implemented the mathematics lessons with music. It was observed that all the children enjoyed mathematics while getting involved with music. To ensure school home continuity children were asked to make drums at home from recycled materials and bring to class for show and tell. Parents appreciated to be a part of their children's learning process.

Keywords: teacher action research, children, mathematics, music, families

Introduction

Learning mathematics from early years is an important aspect of cognitive development. Mathematics helps children make sense of the world around them and provides vital life skills. Learning mathematics assists children to solve problems, estimate, measure, and develop their own spatial awareness. Therefore, it is important to develop a good disposition towards mathematics among young children.

Teachers play an important role in inspiring and being a role model for children by providing opportunities to learn and develop new skills. However, often teachers confront challenges that their students are not motivated in learning mathematics. By analyzing a problem in specific classroom circumstances, teachers modify their practice to become effective teachers. To examine the interests of children and teaching children according to their interests makes teaching effective. Early childhood teachers use different strategies to motivate children to teach mathematics. Among a variety of strategies, music integration is an effective strategy.

Literature Review

The association of math, music, and cognition persisted across time and culture existed in US public education system. Horace Mann, a founding thinker of public education, used this point when arguing the importance of music education in the core curriculum (Southgate & Roscigno, 2009). Although music class exists in the school curriculum in the public schools,

yet music is regarded as a separate class in the school routine and seldom integrated in the subject area.

The theory of multiple intelligences developed by Howard Gardner (1983) has significantly influenced education. Among the nine intelligences Gardner stated *Mathematical-Logical* intelligence which is the ability to think conceptually and abstractly; *Visual-Spatial* intelligence that is the capacity to think in images and pictures, to visualize abstractly and accurately. *Bodily-Kinesthetic* intelligence that is the ability to control one's body movements and of course *Musical* intelligence is the ability to produce and appreciate rhythm, pitch, and timber. Although critiqued, yet Gardner's (1997) explanation was important: music may be a privileged organizer of cognitive processes, especially among young children. (Choy & Kim, 2008).

Connection between Mathematics and Music. There is a connection that exists between music and mathematics (Chandler, 2008; Guha & Chakrabarty, 2015). From the works of Pythagoras and Rameau, basic mathematical ideas are inherent in music. (Papadopoulos, 2002). It is true that mathematics can help investigate hidden patterns and structure in music and that approach can be effective in pedagogy of mathematics and STEAM (Mannone, 2019). Chandler (2008) in his study indicated that there is a connection that exists between music and mathematics. Another way that mathematics and music are related is that both feature abstract, rules-based, and are non-phonetic (Chandler, 2008). According to Shilling (2002) the linkage of music and mathematics builds children's perspective of the world.

Studies also have been done to examine a relationship between music and mathematics in terms of memory. Schmithorst & Holland (2004) hypothesized that the correlation between musical training and mathematics proficiency may be associated with improved working memory performance and an increased abstract representation of numerical quantities. They found in their research a statistically significant difference in the neural correlates of mathematic processing between musicians and non-musicians. The musicians were employing a more "abstract" representation of numbers and especially fractions. Spatial task performance was superior after listening to fast tempo music rather than slow, and music presented in major rather than minor mode. The findings are consistent with the view that the "Mozart effect" is a consequence of arousal and mood changes (Husain, Thompson, & Schellenberg, 2002).

The connections between **music** and mathematics are always present. Music, especially, classical music can also help students learn mathematics in a much more enjoyable manner (Crowder, 2008). Music is more than notes conforming to mathematical patterns and formulas; it is exhilarating because of the intricacies of occurring patterns. Whether these patterns resemble mathematics has no relevance to many musicians. Musicians are inclined to practice music because of the wonders and awe that they feel for music even if they are not aware of the mathematics that is in music (Zhan, 2008).

Music and Mathematics Skills. Many research studies suggest that music enhances mathematics skills. Evidence supports the positive effects of music on one's mathematic ability. Research suggests that young children, who were trained in music, tend to have improved mathematic skills (Zhan, 2008). From young children to adult, studies indicate that music helps in mathematics. Functional Magnetic Resonance Imaging (FMRI) was performed on fifteen adults, seven adults with musical training since early childhood and eight without, while they mentally added and subtracted fractions. They found that the correlation between musical training and mathematic proficiency may be associated with improved working memory performance and an increased abstract representation of numerical quantities (Schmithorst & Holland, 2004).

Further, Rauscher (1993), found that mathematics test scores for preschool-age students increased for those who received instruction in piano, rhythm or singing. The students who studied rhythm had the biggest impact. According to Rauscher (1993), rhythm is, after all, "the subdivision of a beat". It is about ratios and proportions, the relationship between a part and a whole -- all material from math classes. The ability to write mathematical proofs is also associated with Spatial-Temporal (ST) reasoning. Proof writing requires intuitive sense of natural sequences and the ability to think ahead several steps (Zhan, 2008). In the same study, Zahn (2008) mentioned that medical doctors found certain regions of the brain such as the corpus callosum and the right motor cortex, were larger in musicians who started musical training before the age of 7. Researchers suggested that the Mozart's effect on the Spatial-Temporal reasoning is crucial in mathematics. Geometry and aspects of calculus require ST reasoning due to the transformations of images in space and time (Zhan, 2008). The part of the cortex containing the repertoire of Spatial-Temporal firing patterns can be excited by music and is utilized in higher brain functions such as ST thinking in mathematics. Music targets one specific area of the brain to stimulate the use of Spatial-Temporal reasoning useful in mathematical thinking. Zhan (2008) emphasized sequential skills, rhythm and pitch improve children's math ability. There are two types of reasoning, Spatial Temporal (ST) reasoning and Language Analytical (LA) reasoning. LA reasoning is involved in solving equations and quantitative results. ST reasoning is utilized in activities like chess when one needs to think ahead several moves. The effect of music on mathematics can be termed the *Mozart effect.* The *Mozart effect* was named after the discovery that listening to Mozart's compositions, which are very sequential, produces a short-termed enhancement of spatial-temporal reasoning.

Integration of Mathematics and Music. Since there are a lot of skills that overlap in music and math, music could be a great avenue to teach children mathematics. Often, music teachers are being asked to integrate mathematics standards with their general music curriculum (Jones & Pearson, 2013). The integration of mathematics with **music** will help children achieve national, and state learning standards in mathematics and creative arts. Edelson & Johnson (2003) focuses on an interdisciplinary teaching method with a mathematics and music combination. They emphasized pattern activities within mathematics and **music** combination. Pattern work prepares children for number system patterns, such as alternating odd and even numbers.

Integrating **music** with mathematics does not require musical training or expensive equipment. This enables children to easily learn mathematical concepts, while having fun. Although a number of critiques by art educators have expressed concerns about the use of the arts only as a tool for teaching core disciplines, however, Edelson & Johnson (2012) mentioned that components of developmentally appropriate practice for young children, as defined by the NAEYC (Bredekamp & Copple, 1997), state that mathematics needs to be integrated with songs; children need to understand notation, rhythm, and explore their relationships; children should also have daily opportunities for aesthetic expressions through art and music. Geist, Geist & Kuznik (2012) indicated that children have the potential to be more engaged when listening to steady beats than when listening to verbal-only instructions. According to Edelson & Johnson (2003) teachers can use **music** to enhance the understanding of difficult mathematical concepts and skills. Moreover, Jones & Pearson (2013) demonstrated how a musician and a mathematics educator created elementary school lessons integrating music and mathematics. Students learned basic music theory for example identifying notes and learning their fractional values. They learned about time signatures and how to determine correct note values per measure. The purpose was to illustrate how music teachers could collaborate music with math. The lessons described in this article provided strategies to help music educators and elementary school teachers integrate music with mathematics. These lessons provided strategies to integrate music (reading and notating music) and mathematics (development of understanding fractions). Students were introduced to the concept that rhythm measures time. When putting music on paper, the notes were divided into measures (or bars) each representing a unit of time. (Jones & Pearson, 2013) Similarly, Rauscher and Hinton (2006) in their study assert the part-whole concept necessary for understanding fractions, decimals, and percentages are highly relevant in understanding rhythm. Garland & Kahn (1995) showed that time signatures resemble fractions. The “numerator” telling us the beats in each measure and the “denominator” telling us the type of note that gets the beat. In the study by An, Capraro & Tillman (2013) teachers integrated a variety of music activities with different mathematical content. They found that the music-math interdisciplinary lessons had positive effects on multiple mathematical ability areas.

There are a number of strategies that teachers have adopted in harnessing the power of music to teach mathematics to the children. Educators need to look for different ideas around the world to examine how through music lessons, children could learn mathematics skills. Young (1971) mentioned that music educators have come to recognize the need to include a variety of world music in all music curricula.

Enhancing Mathematics Curriculum with Music. As Diamond & Hobson, (1998) mention music enhances a math curriculum, it creates an atmosphere free of undue pressure and stress; infuses pleasurable intensity, promotes exploration and the fun of learning, and allows the child to be an active participant rather than a passive observer. Since music has the power to enhance the curriculum and creates relaxation and enjoyment for children, then, it is important to integrate music in the curriculum. It is, therefore, important that the teachers of young children realize the power of music and modify their practice to become effective teachers.

Although the above literature supports music integration in mathematics curriculum, the problem still exists how teachers could integrate music with existing curriculum. An important focus of this study was for a pre-k teacher to take initiative with music integration when children were getting unmotivated in the mathematics classroom. As a university faculty, I worked with the Pre-k teacher to initiate a qualitative action research project to integrate music in teaching mathematics with the existing curriculum.

Objective of the research. The objective of this research was to motivate the children in a Pre-k class to learn mathematics through music. "How can music be integrated in mathematics teaching so that children enjoy learning mathematics?" was the research question. The prediction was the students would enjoy learning mathematics if mathematics is integrated through music.

Methodology

Participants. The school was located in Queens, New York. Ninety percent of the children were Chinese American. There were 41 four-year old children in two classrooms. Twenty (20) children were in Treatment group and 21 children in the Control group.

Setting. In this school, mathematics was taught in the traditional method using workbooks in the class with few manipulatives. The children were not showing any interest in learning mathematics. However, children showed interest in music during circle time. They wanted to continue with music and expressed dissatisfaction when it was mathematics time. Therefore, to nurture children's interest in music, in the upcoming scheduled unit on "Penguin", the Pre-k teacher and I planned three ways to integrate music into mathematics: through song, dance and instrument. This idea resonated with the musical intelligence by Campbell, Campbell & Dickinson (1996), focusing on singing, musical notation, curriculum songs, and musical instruments. Further, to make a school-home connection and to continue learning at home, music bags were created so that the children could take those bags home to work with their parents. In that way parents will be involved in children's learning and this project will help connect with families with school. The teacher and I looked at the Common Core Standards and The Mathematics standards to make sure we addressed the standards appropriately. (See Appendix A)

Study Design. In the current study, a qualitative research design was implemented to examine how music could be integrated with mathematics curriculum to motivate and engage children in mathematics learning. The Treatment group had all the lessons integrating music with the mathematics curriculum. There was another similar class where there was no integration of music with mathematics. Children were exposed to music as part of their routine. This class was regarded as the Control group.

In the Treatment group, the lessons included prekindergarten foundation for the common core in mathematics and music. The mathematical concepts that the children were supposed to learn were numbers, quantities, cardinality, positional words, addition,

measurement, patterns, measuring, graphing data, counting and math operations. The teacher decided to assess the project's impact by asking question before, during and after the lesson.

Procedure. In the Treatment group, the classroom was set up in centers. The small groups of students would sit on the rug and the teacher would introduce the activity of that day. Next, the students would to go the art, music, or manipulative center. Based on the activity, the table would be set up with the materials and procedures. When the students were done with the activity, they would go back to the rug to discuss what they learned and discovered.

There were five different lessons for the children (see Table 1). At the beginning of every lesson, either a book was read or a song/video was played on the Smart Board. Every lesson had different learning materials.

Table 1: Procedure of Integrating Mathematics and Music with Learning Materials

LESSONS	LEARNING MATERIAL/ BOOK	MANIPULATIVE	MATH SKILL	TYPE OF MUSIC
LESSON 1	The *Five Little Penguins Slipping on the Ice*	penguin counting cards; match penguins to penguin erasers; penguin popsicles	Counting; one to one correspondence; Subtraction: how many penguins were left	Song
LESSON 2	*Penguin Addition*	Drums, pencils	Patterns; addition	Time distribution with each note; quarter note; rhythm or beats with a drum
LESSON 3	*Where is this Penguin Hiding?*	Velcro book	Positional words: right and left flippers	Song and dance

LESSON 4	Bolang gu	Made Bolang gu instrument with different amount of beans	Compared sounds with different amount of beans and with traditional instrument	Video; Bolang gu instrument; dance;
	Intro to Music	Music math cards and addition flashcard for music notes. Rhythm Round About games	Binary number with zero and one	Music notes
LESSON 5	*Pat -A-Cake*	measuring cups and ingredients- cooking- bake a cake; flash cards	Measurement	Pat-a-cake rhythmic song; song, dance

The *Five Little Penguins Slipping on the Ice* learning material was integrated with the penguin counting cards and with a song. The song involved counting cards where the children had to match penguins to penguin erasers, to find out if the children can identify one to one correspondence. At first, the teacher sang the *Five Little Penguins Slipping on the Ice* to the students. Before the teacher changed the page, the student predicted how many penguins were left. Then the teacher made penguin popsicles and took one away each time. Lastly, the students used penguin erasers to match the number that correlates on the penguin counting card.

The *Penguin Addition* learning material was taught with drums to teach patterns. This book was made after exploring the Internet to find out the length of time needed for each note. The teacher discussed the concept of addition by taking a few pencils. While reading the book the teacher demonstrated the beats on a real drum. The teacher then asked the students if they saw any patterns in the book. The teacher asked questions about quarter notes and addition throughout the book. Lastly, the students explored the different drums and played different beats on it. The students also added the number of beats they played. *Where is this Penguin Hiding?* was with a song on Youtube. The song involved learning positional words and the children danced as they were learning. At first, the teacher put on the penguin song on Youtube. The teacher asked the positional words while reading the book then asked the students where the right and left flippers was. Lastly, the student interacted with the Velcro book to learn about positional words.

The *Bolang gu* learning material was integrated with the bolang gu instrument. First, the teacher showed the students a video of a women playing the bolang gu. Then the students played with the traditional bolang gu. The students made two different bolang gu with different amount of beans. The students put two beans in one bolang gu and put ten in the other bolang gu. Then the students compared the sounds of two different bolang gu that they made. The students also compared the sounds of the bolang gu they made to the traditional one. The teacher then replayed the video and the students danced to the video with their bolang gu. Lastly, the student made two bolang gu based on the traditional bolang gu. Later, they danced to the video with their bolang gu.

Intro to Music learning material was taught with music math cards and addition flashcard for music notes. Then the teacher asked the students question about music notes. The students then went to the manipulative center to play with Rhythm Round About and the Music Math Cards. They applied what they learned about math notes to the games. They learned binary numbers of zero and one with the music notes.

Pat -A-Cake learning material was kept together with the measuring cups and ingredients. The procedure for *Pat -A-Cake* involved cooking. At first, the teacher sang the Pat-a-cake song. Then, the teacher discussed with the student how to bake a cake. Third, the teacher showed the students flashcards of the steps to make a Nutella mug cake. The students then measured the ingredients for the Nutella mug cake. Lastly, the student sequenced how to make the Nutella mug cake and measured the ingredients. Then the cake was put in the oven while the children sang and danced.

The teacher prompted the students to think about open ended questions before and after the experiment by making charts and having discussions. Students who needed more help, were paired up with students who were more advanced. For the bolang gu activity, the teacher helped them staple/glue the two plates together if the students needed help. Then the cake was put in the oven while the children sang and danced.

Role of the Researcher. Once a week the researcher interacted with the classroom teacher for half an hour for 14 weeks. The researcher kept notes and spent time with the teacher discussing about the plan, about the interaction of the children and about the music lesson to find out if the children were more motivated and engaged. The researcher shared new musical ideas based on the children's participation and together the researcher and the teacher identified moments of success and rooms for improvement.

Data Collection. An effective way to keep track of the children's reaction was to keep documentation in a field journal by using running record and anecdotes with dated clips. The field journal was enriched with three semi structured interviews with the classroom teacher conducted at the beginning, middle and at the end of the collaboration with the researcher. The questions focused on the attitude of the teacher about teaching mathematics with music and the ways music could be integrated in the teaching. A systematic data collection took place throughout the unit. The teacher gave a check when the students participated in music and a double check when the students showed

enthusiasm in math activities. She entered a star when the students learned mathematics through music intervention.

Further, the teacher provided weekly logs on the integration of music in the classroom and how the children participated. The logs included an overview of the lesson and the activities each day. The teacher also reflected about the success and challenges of each day's lesson and children's participation record. At the end of the study, the teacher shared about ideas for future improvement.

Results

The children learned numbers, quantities, cardinality, positional words, addition and measurement through music. (Table 2 showing Learning Outcome).

Table 2: Learning Outcome of Children

THE CHILDREN LEARNED NUMBERS, QUANTITIES, CARDINALITY, POSITIONAL WORDS, ADDITION AND MEASUREMENT.
THEY ALSO LEARNED ABOUT DIFFERENT INSTRUMENTS FROM DIFFERENT CULTURE, FOR EXAMPLE THE BOLANG GU AND THE AFRICAN DRUMS.
THE STUDENTS DID THE MATH ACTIVITIES WITHOUT KNOWING THAT THEY WERE LEARNING MATHEMATICS CONCEPT BECAUSE THEY WERE HAVING SO MUCH FUN PLAYING WITH THEIR FRIENDS.
TWO CHILDREN HAD DIFFICULTY WITH INTRO TO MUSIC BECAUSE THEY HAVE NEVER SEEN MUSIC NOTES BEFORE BUT ONCE THE TEACHER REVIEWED IT, THEY STARTED TO HAVE FUN WITH THE ACTIVITY.
AS THE CHILDREN WERE PLAYING WITH THE DRUMS, THEY WERE COUNTING THE BEATS WHILE HITTING THE DRUM ACCORDING TO THEIR SONGS THAT THEY WERE SINGING.

They also learned about different instruments from different culture, for example, the bolang gu and the African drums. The students did the math activities without knowing that they were learning mathematics concept because they were having so much fun playing with their friends. Several different learning materials involving mathematics and music made a huge difference. As the year progressed, the children asked when we are going to sing; three children also asked if they would make drums again. As children were involved with music on their own with mathematics learning, the teacher continued putting stars and we were happy to see the increasing number of stars.

All the children earned checks, double checks and stars continuously. Emily said: "I like cooking with chocolate" (- Pat-A-Cake lesson). Eric exclaimed: "This is so much fun. Can I make another one?" (-Bolang gu lesson). Isabella mentioned: "The penguin is flapping his flipper, so funny" (-Where is the Penguin Hiding? lesson). (Table 3 showing children's enthusiasm).

Table 3: Children's Enthusiasm During the Unit

EMILY SAID: "I LIKE COOKING WITH CHOCOLATE" (- PAT-A-CAKE LESSON).
ERIC EXCLAIMED: "THIS IS SO MUCH FUN. CAN I MAKE ANOTHER ONE?" (-BOLANG GU LESSON).
ISABELLA MENTIONED: "THE PENGUIN IS FLAPPING HIS FLIPPER, SO FUNNY" (-WHERE IS THE PENGUIN HIDING? LESSON).
THE STUDENTS ENJOYED BRINGING HOME RECYCLED MATERIAL TO MAKE THE DRUMS. DURING SHOW AND TELL, ALL THE STUDENTS WERE EXCITED TO TALK ABOUT THEIR DRUMS AND HOW THEY MADE AND WHO MADE IT WITH THEM. THE BEST PART WAS WHEN THEY WERE EXPLORING WITH EACH OTHER'S DRUM AND DISCOVERING THE DIFFERENT SOUNDS THAT DRUMS COULD MAKE.
THREE CHILDREN ALSO ASKED IF THEY WOULD MAKE DRUMS AGAIN.
ALL THE CHILDREN EARNED CHECKS, DOUBLE CHECKS AND STARS CONTINUOUSLY.

Overall, the students seem to have fun during the activities. They like working with each other to figure it out. Two children had difficulty with Intro to Music because they have never seen music notes before but once the teacher reviewed it, they started to have fun with the activity. (Table 2: Learning Outcome)

There was no change in the other class. Parents in the comparative group came to know about the drums and asked us if we are also going to do a *show and tell* with drums in their class. The control group was allowed to experience the treatment of integrating music with mathematics after the study was finished.

During the project, music bags were created for the students to take home. The bag consisted of an introductory letter to the parent explaining the content of the bag, materials and books and musical instruments, procedure and a survey questionnaire to find out how the child enjoyed working on music and mathematics at home. One of the items was to make a drum with recycled materials. The step-by-step procedure of making a drum was explained in the bag. The parents and the students enjoyed bringing home recycled material to make the drums. During show and tell, all the students were excited to talk about their drums and how they made and who made it with them. The best part was when they were exploring with each other's drum and discovering the different sounds that drums could make. As the children were playing, they were counting the beats while hitting the drum according to their songs that they were singing. Overall, the parents loved taking home the music bag and spending time with their children to learn about the week's theme.

The parent survey questions were: How much does your child enjoy music? How important is to incorporate music in the academic curriculum? One parent mentioned that she would rather have children sing math songs than play video games. Another parent mentioned

that with learning music “my child not only learned math but also English”. Since the children were Chinese American and not all the parents spoke English fluently, hence English songs were very much appreciated. Making drums and bringing to class for *show and tell* was the excitement of all. The children were so happy to show off their drums they made. They described the whole process of how they made their drums. All the parents agreed that mathematics and music are important part of the academic curriculum.

Discussion

The action research study helped the teacher and myself to take a fresh look at our efforts to encourage children to enjoy learning mathematics with music. Learning mathematics is an important area and so also learning music. Looking at the enthusiasm of the students and the support from the parents, the teacher wanted to continue teaching mathematics involving music as it contributed to effective teaching.

This research is aligned with Horace Mann’s thinking that music should be integrated with the core curriculum. Indeed, this research echoed the same as Gardner’s (1997) statement that music was the organizer of cognitive process. This study confirmed the connection that exists between music and mathematics as also indicated by Chandler (2008), Chandler (2008) and Guha & Chakrabarty (2015). Similar to the study by An, Capraro & Tillman (2013), the UPK teacher in this study also integrated a variety of music activities with different mathematical content. The music-math interdisciplinary lessons had positive effects on the children with learning of mathematics. The findings in this study were consistent with the view that the "Mozart effect" is a consequence of arousal and mood changes (Husain, Thompson, & Schellenberg, 2002).

Since there are a lot of skills that overlap in music and mathematics, therefore this study indicated that music could be a great avenue to teach children mathematics. This study echoed the same as the study by Edelson & Johnson (2003) who focused on an interdisciplinary teaching method with a mathematics and music combination. Here also the teacher emphasized pattern activities within mathematics and **music** combination. Further, this research demonstrated that integrating **music** with mathematics did not require musical training or expensive equipment. As mentioned by Edelson & Johnson (2012) that components of developmentally appropriate practice for young children, as defined by the NAEYC (Bredekamp & Copple, 1997), stated that mathematics needs to be integrated with songs; children need to understand notation, rhythm, and explore their relationships; children should also have daily opportunities for aesthetic expressions through art and music. The UPK teacher incorporated all of the above developmentally appropriate practices. In agreement with Geist, Geist & Kuznik (2012) this study also indicated that children have the potential to be more engaged when listening to steady beats. The biggest impact on the students was in rhythm with the drum making and that is similar to the findings by Rauscher (1993).

Music enabled children to easily learn mathematical concepts, while having fun. Children practiced mathematics because of the wonders and enjoyment they felt for music and tend

to have improved mathematics skills as in the study by Zhan (2008). This study resonated the same tune with Diamond & Hobson, (1998) mentioned music enhances a mathematics curriculum, it creates an atmosphere free of undue pressure and stress; infuses pleasurable intensity, promotes exploration and the fun of learning, and allows the children to be an active participant rather than a passive observer.

Since music has the power to enhance the curriculum and creates relaxation and enjoyment for children, then, it is important to integrate music in the curriculum. From this study therefore, it can be concluded that it is important that the teachers of young children realize the power of music and modify their practice to become effective teachers.
In the future, to further music and mathematics concepts, we would introduce air instruments and string instruments. Then we would compare instruments from different countries based on their sounds and structures. The limitation of the study was all the lesson plans were on penguins as *penguin* was the scheduled unit, so for future lesson plans we would include different animals and what sounds they make to communicate with each other. Although integrating music with mathematics is not a novel idea however, this project indicated that children need different ways other than traditional method to learn mathematics. The excitement that was generated among children and among parents was a rewarding experience. The parents really liked the idea how music was integrated with mathematics learning.

Implications

This project was effective because not only did the children enjoy the project, but the parents appreciated too. This project has taught us that music helped students grasp mathematical concepts effectively and in an enjoyable manner. The project made us think about individual student and their needs and interest. Two children were falling behind in mathematics and those children became enthusiastic learners with integration of music. New York State has placed emphasis on teaching the standards and this kind of action research project helps us integrate teaching children, addressing teaching standards, while children enjoy learning. Like Mannone's study (2019), this research was effective for the pedagogy of mathematics and STEAM. Music helped students be better learners. Students started loving mathematics and hopefully will continue loving mathematics through their educational career and in life.

Conclusion

The purpose of the study was to motivate the children in a Pre-k class to learn mathematics through music. The children learned numbers, quantities, cardinality, positional words, addition and measurement through music. They also learned different instruments from different culture. It was amazing to see the students do mathematics activities without realizing that they were learning mathematics concept because they were having so much fun playing with their friends. With the increase in the number of stars children were receiving, it was obvious that the children were enjoying the combination of mathematics with music.

The teacher although was nervous at the beginning to integrate music with mathematics but became more comfortable gradually. Her confidence level gradually increased while she was integrating mathematics with music. She told me how it was challenging at the beginning when the children were disinterested in mathematics. She tried so many ways but, she felt music integration was the most effective strategy of all. She mentioned how she enjoyed every lesson and the excitement that was generated with the drum *show and tell* was the rewarding experience. Overall, the project of integrating mathematics with music was very successful for the children as well as for the teacher and made the families happy and involved in the children's learning process.

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Appendix A: Link to Standards

New York State Pre-Kindergarten Foundation for the Common Core:

http://www.p12.nysed.gov/earlylearning/standards/documents/PrekindergartenFoundationfortheCommonCore.pdf