# The relationship between math and music

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# Introduction

Mathematics refers to numbers and calculations, often dealing with magnitudes, figures and quantities expressed symbolically. On the other hand, music is an art of sound through the use of harmonies, rhythm and melodies. Although these two subjects are in contrast to each other, as mathematics is often unpopular to most people for its difficulty and music is easily likeable for its pleasantness, experts have uncovered a strong connection between the two topics.

The connection between mathematics and music is held through the concepts of numbers, patterns, and ratios. Through these mathematical concepts, many music theories were developed. Great mathematicians like Pythagoras, also a renowned music lover, applied mathematics to expand his ideas on music theory. Similarly, famous musicians like Boethius used mathematical concepts to express his musical ideas. These people used mathematical concepts to understand music, and somehow music also helped them to accomplish great things in the field of mathematics.

Music helps enhance one’s mathematical skills by training the brain to think critically and analytically, developing one’s sequential and rhythmic skills, and stimulating the use of spatial reasoning, all of which are useful in solving mathematics. This music theory became famous when study on the Mozart Effect was developed in the late 1950s. Mozart effect is a theory in which one can improve his intellectual performance by listening to Mozart’s compositions. This theory led researchers to study further the correlation

between mathematics and music and to prove whether this relationship exists or not.

A. Statement of the Problem

This paper aims to answer the following questions: (1) What are the theories on the relationship between mathematics and music? (2) What are the mathematical concepts used develop musical theories? (3) What are the proofs that music helps enhance one’s mathematical skills?

B. Significance of the Study

This research will be able to aid those students who need help with their studies, not only in mathematics, but also in other subjects as this research will demonstrate how a student may be able to improve his skills in all kinds of aspects. This research will help them develop their sequential skills, spatial reasoning, and critical thinking.

From this research, parents will have the knowledge on how to assist their children on their studies. This research will provide numerous statistics that will show how music aids a child’s learning ability, and will prove this not only with conjectures, but with concrete proof. In the end of this research, a survey will be given to a class of 21 students to support this study.

It is of utmost importance that every child is to be given the best education he can have and that is why this research is conducted to let people be aware of the benefits that listening to music can give, some of which are aforementioned.

Body

A. The Relationship between Music and Math

Math and music easily relate to each other. In the field of math, there are many different basic concepts that can be easily applied to music. These are:

(1) Numerical Operators Numerical operators are about understanding and comparing numbers, and in relation to music, we count the beats inside a rhythmic pattern, and compare the beats in different kinds of measures (4/4, 3/4, 2/4).

(2) Geometry Geometry is all about shapes and spatial understanding an in music, we can compare this to organizing notes of which are higher or lower, passing through or inside the bars, and many more.

(3) Measurement Measurements are used immensely in music. Using system of measurements, we learn how to compare the tonality of each note, the pace of every rhythm, and the remaining beats left to complete a measure of ¾.

There are many theories in both fields of Math and Music that have a close connection to each other. Here, we will be able to prove the relationship between music and math by discussing the applications of math to music, and vice versa, musical theories, mathematical concepts, and studies about the correlation between math and music by professionals.

1. Applying Math to Music

Math and music can both aid each other through different means. Math was first applied to music by harmony, tones and tunings constructed by the Ancient Greeks.

In the Greek era, music was regarded as a mathematical discipline. In other words, music was the science of sound. The Greeks were also the one who discovered that notes of the same base frequency sound most pleasant to the ear. For example a 100Hz tone sounds pleasant when combined with a 200Hz, 300Hz, 400Hz and 500Hz frequency. The most important ratio of frequency became 1: 2, where we developed the idea of octaves. Even here, we can easily see how we can apply the concepts of ratio and use them to combine harmonic tones that go well when played with each other. It was based on the Greeks' studies that later on, famous musicians made use of not only tones of the same base frequencies, but also tones of frequencies that have developed patterns.

One very amusing mathematical concept is the Fibonacci sequence (1, 1, 2, 3, 4, 8, 13, 21, 34…) where the first two elements of the set are both 1, and the succeeding number is obtained by the sum of the two preceding numbers. The ratio of two adjacent numbers is what we call the Golden Ratio which is approximately 0. 61803398….

Apart from this, the golden ratio is also what we call the point of division in a line, where the ratio of the bigger segment to the whole segment is equal to the ratio of the smaller segment to the bigger segment. This mathematical concept is also greatly used in the music industry. Several studies have uncovered that this golden ratio appeared in many famous compositions like

“ Hallelujah”, “ King of Kings” and many of Mozart’s piano sonatas. The golden ratio, found to be in the patterns of numerous famous compositions, when put into music, make such beautiful patterns and rhythms that theoretically may have helped in making these well-known songs famous.

Although these mathematical techniques are too complex to take such notice of, they still prove the close affinity of math and music, and of how math can be applied to music in order to produce harmonic sounds. However, there are also mathematical techniques that even a regular person knows that can be applied to music. These are, of course, geometry,

measurements and numerical patterns, as said before. These concepts, along with the mathematical theories mentioned above prove that math not only has a very close relationship with music, but also the great help that these mathematical concepts have given to the music industries.

2. Applying Music to Math

As mathematical theories, concepts and techniques have helped improve music through the years, music has also been proven to be a great help in the field of mathematics. Based on studies, children can improve their math skills by not only playing musical instruments, but also by just listening to music.

Children who start to learn playing musical instruments at a very young age tend to have well-conditioned minds because formal music training needs focus and discipline, and once they have, this ability can be shifted into other

areas of a student life, especially in the field of mathematics where focus and discipline is a requirement.

Music lessons require a child to learn the different keys, tones, beats, and rhythms in music. Moreover, once a child has learned the tonality through these lessons, he has already been exposed to sequences and patterns. Should he be presented similar challenges in a math class, he will find it easier to cope up with these math lessons. In the process of learning sequences, rhythms, and bars, a child can develop his own sense of logic, and use this logic in mathematical counterparts. These music lessons can greatly help a child, to easily understand the basic lessons in mathematics.

A child can improve his math skills not only by playing any musical instrument, but also by listening to music. For the past years, studies have been conducted in order to prove the said connection and theories were then made and one of the most popular theories on how music can aid children in learning math is called the Mozart Effect. The Mozart Effect is a theory that states that by listening to classical music, particularly Mozart’s composition, can allow the brain to reorganize and fasten its development.

Basically, the human brain has two types of reasoning: spatial reasoning and language reasoning, the former of which the Mozart Effect is known to enhance the brain with. Spatial reasoning is a process in which you manipulate images in your mind and form a logical sequence. Based on studies by professionals, Mozart’s compositions is known to be sequential, not only in the aspect of the Golden Ratio but also in frequently having his compositions divided into 3 parts: A, B, C. Mozart’s compositions usually

come up with a pattern like ABCAB, ABABC. These patterns help motivate brain cells as proven by neurological research.

Current studies support the claim of the Mozart Effect theory. In neurobiological research, musicians who started training at a young age were found to have certain parts of the brain larger than usual. This part of the brain, incidentally includes the collection of spatial firing patterns, of which can be keyed up by music and developed into higher brain functions. This means that when one listens to music, it triggers the nerve cells in the brain that is responsible for spatial intelligence.

True, music has been a great help to those who need to boost their math skills by triggering the brain cells, but there is also a simpler way of improving their math skills. This is of course, about songs that have actual lyrics related to math. Songs with mathematical lyrics help students in memorizing and understanding mathematical concepts easily. (See appendices A and B for lyrics.)

Mathematical concepts have been easily applied and related to music and have been a great help to the music industry, however, only few know that listening to music and having music lessons can also greatly help in improving one’s math skills. This knowledge is also very important as this may help many children who do poorly in mathematics to improve a lot.

B. Surveys and Statistics

A study was made and tested on 237 students who were given piano training and math software to take note of their improvement in math. After months

of piano training, a mathematics test was given to the students, and also to others who did not have any music training. This group of students scored higher in proportional math and fractions test by a margin of 27% than those who did not receive any music training.

Another study in the University of California that after students had eight months of piano keyboard lesson, preschoolers demonstrated a boost of 46% in their spatial reasoning IQ test. 2001 SAT results showed that students who had music education scored higher than students with no music instruction. Students in music performance scored 57 points higher in the verbal test and 41 points higher in the math test while students in the music appreciation class scored 63 points higher in the verbal test and 44 points higher in the math test.

In the class of 21 students (IV-1), 10 students who had formal music education for an approximate of 5 years had an average score of 92. 50 in their math grade, whereas the other 11 students who had no formal or little music education had an average score of 87. 27 in their math grade.

Based on these studies and statistics, one can clearly see the big improvement on math on a student who has undergone music lessons than those who did not.

Summary and conclusion

Math and music both aid each other almost in every aspect. There are many ways one can use different mathematical concepts, techniques, and theories to aid in musical learning and there are also benefits that one can gain to

improve his math skills by listening to music or by having music lessons. Mathematical techniques such as geometry, measurements and numerical operators aid in understanding beats, rhythms, and patterns in music. Mathematical theories made by the Greeks help improve music harmonies. Math concepts like the Fibonacci sequence and the Golden ratio have also helped a lot in music industries.

In a scientific perspective, listening to music conditions the brain to thinking critically, sequentially, and logically. Based on the famous Mozart's theory, music helps enhance one's mathematical skills by training the brain to think critically and analytically, developing one's sequential and rhythmic skills, and stimulating the use of spatial reasoning, all of which are useful in solving mathematics.

Math and music may have a close affinity with each other, but that doesn't mean that a music lover also likes math, or a mathematician is also a musician. These studies have been made just to prove their relationship, and how math and music can aid one another. However, just totally relying on music to aid one in his math skills will not work; he must still strive hard, but as research proves, listening to music will still be indeed of great help to one's math skills.