AUDIBLE MUSICAL FREQUENCIES

The model described aims to propose an analysis of some of the mathematical instruments useful for the recognition of musical frequencies in everyday life.

Overview "AUDIBLE MUSICAL FREQUENCIES"

Context
Everyday life

How to calculate the musical frequencies in everyday life starting from the simple listening of sounds attributable to mnemonic functions

Cognitive processes
Managing situations
Analyse situations
Processing of information

Content

Multiplication
Divisions
Addition

Target group (incl. necessary prior skills and competences)

Adults and young adults;

Learners are familiar with mathematical calculus and listening to music;

Dispositions
Flexibility
Curiosity
Collaboration

Outcomes and results

Learners will understand the effect of calculating the different musical frequencies and will be able to reproduce them in their daily experience.

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Main information

Content	Natural numbers; decimal numbers, fractions identifying the writing time of a musical piece and its traceability to frequencies recognizable in everyday life
Target group	Adults and young adults; Students are familiar with mathematical calculus and listening to music, they are people looking for instruments for the recognition of frequencies, which are alternatives to the human ear.
Learning intention	Numeracy for personal and private purposes
Duration	Approx. 3 hours
Material and resources	Historical sources related to the history of music education and mathematics (creation of a link between the two disciplines).
Group size	4 students
Problem statement	Researching the musical frequencies of everyday sounds, through mathematical instruments.
Working questions	- What is a frequency (high and low)? - What are the systems to calculate it? - What are the consequences from the point of view of the instrumentalisation of frequencies in everyday life?
Learning outcomes and results	Students will understand the effect of calculating the different musical frequencies and will be able to reproduce them in their daily experience.

Working plan

Time (lessons)	**Description of content/activity**	**Material**	**Methodical and didactic information**
30' +	**1.Discover** This activity is conducted initially simply by guiding the discussion with some questions, also to evaluate students' knowledge related to the topic. As a result, the teacher will understand whether or not it is necessary to deepen the concept of urban subdivision.	Slides and listening to music tracks and frequencies (reconducible to multiple genres)	Discussion [if you need explicit teaching]
60'	**2. Calculate Frequencies** Learners are initially asked for a simple listening to the songs. A brief discussion of the proposed ideas follows and finally, if necessary, the teacher shows, explains and makes comprehensible the mathematical formula to calculate exactly the frequencies and the mathematical musical subdivision of the pieces listened to. In closing, different situations are subjected to learners and are asked to calculate a given frequency of a certain piece, using objects and tools of everyday life.	Consistent situations and calculations	Discussion Collaborative learning Explicit teaching
45'	**3. Evaluate the different proposals** The teacher provides various frequency calculation proposals and asks the learners to evaluate the most useful to be able to discuss together about its use in everyday life.	Calculation situations with fractions to identify musical times and frequencies	Collaborative learning (couples)

30' +	**4. Discussion** The Working Groups share the assessments and considerations that emerged during **phase 3.** a phase of exchange of views followed.		Discussion Feedback

Appendix

1) https://www.disma.polito.it/content/download/386/3464/version/1/file/SEM_2016_1_MAT-MUS_Storia.pdf

2) Giovanna Mazzon – Linkedin

To notice the correlation between **music** and **mathematics**, was already an ancient Greek thinker, **Pythagoras** whom we know to be the author, among other things, of the Pythagorean scale: the musical system used in ancient Greece for the construction of the scale (the succession of the 8 sounds representing the notes).

Pythagoras was the first to found the study of music on a mathematical basis. The anecdote tells how Pythagoras discovered the bridge between music and mathematics when one day he heard a blacksmith beating hammers of different weights on the anvil. He noticed that depending on the weight the **frequency** of the sound varied, producing more or less pleasant dyes. Investigating why, Pythagoras realised that hammers whose weights were in precise ratios produced pleasant consonant sounds.

Pythagoras for his studies of musical theory used the **monochord**, an instrument that, as his name suggests, was composed of a single string, stretched between two bridges over a harmonic case; under the rope a third intermediate and movable bridge allowed to divide the rope itself at will, giving rise to different sounds.

From his experiments on the monochord he understood that a **string** put into **vibration** produces a sound whose "height" perceived by the human ear is in close relation to the length of the string itself.

Of course, Pythagoras could not come to conceive the link between the height of a sound and the frequency of the associated sound wave; the more he simply realised that the longer the rope is, the more the note produced is perceived as "low" or "serious"; on the contrary, a shorter string produces a note that is recognised as "higher" or "acute".

But the great Greek mathematician did not stop at this elementary consideration. In fact, he had the idea of associating each note to a number, precisely the inverse of the length of the string responsible for generating the sound itself. For example, he associated the note produced by a rope 1 meter long to the number 1 and the note produced by a half meter long rope to the number 2.

Thanks to this use of the inverse of the length, more acute notes are associated with larger numbers, in order to reconcile the height of the note with the height of the number that represents it.

In addition, using this method, each note is characterised by a number that is in fact proportional to its frequency.

Among the various **forms of art** we understand how music is perhaps the one that has the closest connections with **mathematics**. And it is no coincidence that many artists consider musical language the transposition of mathematical principles on the pentagram. Nor is it a coincidence that in the Middle Ages music ended together with arithmetic, geometry and astronomy, among the sciences of the quadrivio: the disciplines that, together with the literary ones of the trivium, represented the educational standard of the culture of the time.

Many other thinkers and musicians, even in more recent years, have questioned the correlation between numbers and sound, rhythm and arithmetic. Researcher **Emma Gray**, a clinical psychology expert who specialises in educational psychology at the **British Cognitive Behaviour Therapy and Counselling Service in London**, has done a study that certifies that listening to classical music helps to have a better performance in mathematics.

According to scientists, this also has a **physiological foundation**. In fact, frequencies, tones (or notes) and chords that, transmitted to the brain, are then reworked, come to the ear while listening to music. Pleasantness is caused by the neuronal circuits that activate. Music in fact determines the release of **dopamine**, an important neurotransmitter that acts directly on our body, increasing the heart rate and blood pressure determining in us moods of well-being.

LEARNINGS OF CONVERSION FROM MUSICAL NOTES TO AUDIBLE FREQUENCIES

https://www.audiosonica.com/it/corsoaudio-online/conversione-tra-note-musicali-e-frequenze-appendice-i

An example of an easily playable piece in everyday life, having “uncoded” musical strumrnti available that reproduce known frequencies – We WILL ROCK YOU by QUEEN

With that rhythmic beat of feet and hands along with a chorus that sounds like an anthem, **Queen**’s “We Will Rock You” is still one of the most famous and representative songs of the band once led by Freddie Mercury. Released together with “We are the champions” as a single from the 1977 album, “News of the World”, the song and the second track of the British line-up’s sixth studio album owe part of their realisation to the enthusiastic behavior of the group’s fans to its shows that with a beat of feet and hands followed the intro of the song.