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Study of a Guitar and its Music: Interdisciplinary Approach

Carmen Mihaela NICULESCU

Liceul Teoretic "Mihail Sadoveanu", Bucharest, Romania

carmenprofro@gmail.com

Sorina CRETU

Colegiul National "Spiru Haret", Bucharest, Romania

sorina2005c@gmail.com

The stated purpose of education at any level is that the notions that the teenager has to learn are notions which are useful to his development in society. This means that, when creating any type of content, one must take into account this necessity, and the student must be made aware of the respective necessity.

A motivational education in which, during the process of teaching, the teacher fills the notions he teaches with emotion, can only be an education that fulfills its purpose. Starting from what is necessary to a teenager in an international, European and primarily national context, teaching through topics of interest can be a viable solution.

When establishing the topics and the complexity of the notions that should be studied, we will obviously take into account the age group that we are addressing. Our experience as teachers is with the age group 14-18. At this age, a topic that appeals to all young people, regardless of their level of education or the social environment from which they come is *music*.

The topic will be spread throughout multiple classes during which teachers of various specializations will work together, having a common denominator, namely what does the teenager wish to know?

The topic will begin with the teacher finding out the favorite musical genres of the students in a class. The majority's favorite genres will be written on the blackboard and will represent the basis for any interpretation that the teachers will make.

The music teacher will start by defining the notion of musical genre, which encompasses musical pieces that have a similar approach in terms of melody, harmony, rhythmic, form, instrumentation and literary text (where the case may be). The rhythm and the measure of the majority genres chosen by students will be discovered.

Defining the rhythm and the measure in music as the regular and selective stress laid on some sounds from a series of sounds, can be likened to the rhythm of a literary work, which represents the regular succession of the stressed and unstressed syllables in a verse.

The teacher can point out the parallels between the rhythms of various musical styles and the rhythm and metrics discovered in various poems. Furthermore, he can point out the rhythm of various styles, like the waltz, and the metrics found in the poetry from the beginning of the 19th century. Through the collaboration of the music and literature teachers, we can do an overview of the major influences found in the music and poetry of various stages of artistic development.

Coming back to the music that appeal to the majority of young people, we can detect, by listening to a musical piece, the rhythm, so that we can further define the melody as a succession of sounds combined using the rules of rhythm and modulation.

At this point we can ask what exactly the sound is, and the answer will come in collaboration with the Physics teacher. In the above described context, the teacher will define mechanical oscillation (which represents the source of a sound) and then the mechanical wave which represents the propagation of sound in a medium.

The teacher will define frequency, wavelength, the speed of the sound and its amplitude. The greater the amplitude of a wave, the harder the molecules hit the eardrum and the sound is heard louder.

Any simple sound, like a musical note, can be described in its entirety, specifying three perceptive characteristics: height, intensity and quality (timbre). These characteristics correspond exactly to three physical characteristics: frequency, amplitude and shape of the wave. Noise is a complex sound, a mix of different frequencies, or notes which are not harmoniously connected. In order to understand why we perceive the same sound differently depending on the location in which it propagates, we will define the phenomena of reflection and refraction of sounds (of mechanical waves in general) and the phenomenon of interference, as the superposition of waves having as a result maximum and minimum values of interference (nodes and antinodes).

Throughout the entire scientific discourse, we should not lose sight of the students' interest. For example, since many students want to sing and record their own song, all the explanations of the above mentioned phenomena will start from the way in which the soundproofing of a studio is done (the construction of the walls). We will also discuss how a concert hall is built (for example, in Bucharest, the Romanian Radio Hall has had its chairs changed because of their inadequate shape, which affected the acoustics of the hall).

The source of a sound is also a starting point for the explanations. We can start from a sound made by a guitar and start the analysis by asking whether its shape and size are accidental. The shape involves notions of acoustics and the size notions of mathematics.

We can measure the chords of the guitar from a fixed point to the various frets from the fretboard. These lengths do no form a random

sequence, but are the terms of a geometric progression. At this point, the math teacher can define what geometric progression is. He can then go on to define the notion of recurrence. He can then go on to look for different recurrences in other examples in nature and will very quickly reach the Fibonacci sequence, which we can find in multiple proportions.

Without moving away from music, we can make correlations between mathematics and physics, showing that if a string size L emits a sound, for example "mi", then a string size L/2 emits the sound one octave higher and so on, obtaining a recurrence of values. From the mathematical point of view, the notes mi, fa, fa #, soil, soil # , la, la #, si, do, do #, re, re #, mi, are obtained from the string lengths L0, L1, ..., L12, and they represent a recurring sequence of values. It is clear that the same system of construction can be found in any instrument with chords and in conclusion the construction of an instrument is not at all accidental, but recreates proportions that nature itself offers.

We can analyze the music that the students like from the point of view of the receiver. This analysis can be done anatomically or psychologically. Anatomically, the biology teacher can explain about the ear as an auditory analyzer and the transmission of the sound signal from the receiver to the cerebral cortex. He will make the distinction between the primary auditory area, which decodes definable sounds (located in the superior temporal gyrus) and the secondary auditory areas, which decode hissing, whistling.

The transmission of the sound signal pertains to the communication between neurons. This is possible due to synapses, which can be electrical or chemical. At this point, the biology teacher can explain in detail the relationship between neurons.

Music is a stimulus that causes the brain to release dopamine, called the hormone of happiness. Moreover, it seems that the effect it produces on us listening to favorite songs increase a state similar to excitement. In these cases we meet symptoms such as dilated pupils, increased heart rate and blood pressure. A large amount of blood is diverted to the muscles in our feet and here is the need to beat feet keeping the rhytm of the music.Music has many effects on our body. Among them we can mention easily: decreased emotional tone, relaxation, euphoria, stimulation will initiative, will increased self confidence. In order to understand these phenomena, the explanations must be correlated by the biology, chemistry and physics teachers, always maintaining the overall perspective.

Research on deafness led to the conclusion that deaf people have, generally speaking, a very low level of empathy. A first conclusion would be that sound has a great significance in developing one individual's emotional intelligence.

We ask the question: "*does the music we listen to form your personality or does your personality dictate the music we listen to?* " This question is due to Peter Jason Rentfrow and Samuel D. Gosling from The University of Texas in Austin, USA in 2003, when they collected data on music preferences using a special Short Test of Musical Preferences STOMP. Also

Etienne *Benson* (2003) was preoccupied by this theme in article "*You are what we listen"* published in Journal of Personality and Social Psychology.

The psychology and biology teachers will help us answer this question. The philosopher Friedrich Nietzsche stated that: „Life without music is simply a mistake, a pain, an exile."

Starting from the definition of the various personality types, the psychology teacher can make a few references to musical psychology, which establish the connection between music and education. We can adjust personality tests presented by *Rentfrow and Gosling* (2003) in article "The Do Re Mi 's Everyday Life – The Structure and Personality Correlates of Music Preferences", *which would then be corroborated with the respective student's preferred musical genre (p. 1236-1238).*

According to Professor Adrian North from the Heriot-Watt University in UK, the first one who has done such correlations, *a certain personality prefers a certain musical genre* (North, Desborough & Skarstein, 2005: 1903)[1].

The important study mentioned above and conducted by psychologists Jason Rentfrow and Samuel D. Gosling express in detail "*the link between personality and chosen musical style*" like:

- *"Individuals can accurately assess the level of creativity and open minded capacity of a stranger just evaluating his' most favorite ten songs".*
- *"People who listen to Jazz or Classical music tend to have an IQ above average".*
- *"People who listen to Country or TEN TOP radio charts tend to be more conventional to think simple - avoiding complex things".*
- *"There is no clear link between sexual or verbal aggression among young people and the favorite music they are listening. The study concluded that young people who prefer listen to rap or heavy metal are generally shyer and more reserved than others".*
- *"Extroverts preferred music with a strong bass".*
- *"It seems that background music helps extroverts work better, but the same background music is tormenting the introvert".*
- *"Motivational tracks do not help athletes to overcome performance. From personal experience it is good to prefer motivational songs when you are running, for example, not necessarily to run more, but to distract your mind from the effort"* (Rentfrow & Gosling, 2003: 1242-1251).

At this point in the discourse, the student is faced with a varied range of interpretations of a single phenomenon: MUSIC. From "*the scientific interpretations offered by physics, mathematics, biology, to the artistic interpretations offered by music and literature, the student can see things in their entirety, exactly as they are in our life"* (Rentfrow & Gosling, 2003:1252).

Depending on each student's skills, he or she will be willing to remember the scientific or artistic interpretations. The important thing is that he will understand reality in its complexity and he will also understand that, depending on his own abilities and personality, the accent in explanations will fall on one aspect of reality or another.

Another major advantage of this kind of discourse is the fact that it can form generalists who, working together with specialists, can more easily find answers to the essential problems of the society in which we all live.

Essentially in building teaching approach we might need to leave the knowledge that students already own and we will show them what students have resolved in that area. Such students are not just spectators, but may become problem solvers in a day. Interdisciplinary understanding of the phenomena around us is a way of perceiving the reality to be educated. Also the teaching approach needs to be left to the beneficiary necessities (essentially of the student) and from that point he should be conducted to knowledge and in any case must not start from the teacher's needs. The essential purpose of the educational process is to form youngs eager of knowledge, ready to discover, to explore new horizons for our society.

That is a proposal for a teaching approach in Mathematics. In mathematics - chapter strings recurring progressions, recurring nature of order 1 and 2, teacher aims to meet the needs of different students coming from a classroom. Questions approach imposed by the teacher during the theme could be:

- How can I help students to contribute to their own training?
- How can we discover the different needs of students?

Behind the numbers, sequence numbers in string properties are distinct geometric or graphic interpretation that correspondence in real life people and nature itself. Their modeling means in modeling processes will bring us answers to many unknown equations such as "who is the next number in the following given string?" Recurrence strings combined with mathematical induction process will bring useful applications owned by Weierstrass based on the Fibonacci sequence and observing actual strings.

The essential question to which students respond in the chapter is: How can I use math to discover new properties and relationships? Unit Questions of this theme are: Are there rules or laws in the organization structure of living? Are the results important in the analysis of recurring strings converging or diverging? Is vivid the visual impact of the structure rendering of the structure of recurring strings?

Here are some expected results / outcomes: Students will apply properties recurring strings using Weierstrass property and the principle of mathematical induction. Students will model the graphic properties in the formulation of real processes based on recurring strings. Students will calculate the recurring strings limit the study of qualitative and quantitative information given recurrence or recurrence of order 1, order 2 and other forms of recurrence. Students will do inductive connection

between the strings and the real numbers as a basis to establish and verify the results and get / find new properties.

For a proper teaching approach teacher will propose the following objectives:

O1 - remind pupils recurrence of arithmetic progressions and geometric and mathematical induction principle.

O2 - students introduce recurrence using minimum 3 situations.

O3 - students differentiate recurrence of order 1, 2 and establish the order of the original terms.

O4 - students will determine convergence and no convergence by Weierstrass theorem.

O5 - students interpret modifying a natural phenomenon and explain the recurrence of the guitar or the shell example.

O6 - students will distinguish recurring rows with finite limit and infinite limit by connecting them with real situations, see the universe and surrendered sunflower.

O7 - students will find the recurrence relation formula for rabbits problem; they will determine the components of Fibonacci sequence and then the ratio of two consecutive terms and then the number φ.

O8 - students will deduct the number of gold 1 / φ and will argue its presence through different examples of spirals.

O9 - students will decide on changing or not changing logarithmic spiral structure in at least 2 examples of living (human body, plant life, medieval architecture or painting).

Questions of mathematical content that students may respond by this approach are: What are arithmetic and geometric progressions and what forms of expression are known? Present at least 4 exercises. How we use mathematical induction principle in formulating the general term of arithmetic and geometric progressions? Present at least 4 exercises. How to describe the terms of a string expressed recursively? Present at least 3 exercises. How correlated with recurrence strings descriptions offered? Present at least 3 descriptions. What recurrent patterns identified natural phenomena indicated (guitar, shell, painting, art, medieval architecture, and development of plants in floral surrendered)? Present at least1 natural phenomenon. What is the procedure to determine the convergence of recurring strings and general term recurrence formula of order 1 and order the two? At least 3 each exercise for each type of recurrence. What is the solution of the rabbit's problem expressed by the formula of recurrence and the ratio of two consecutive terms in the string and leading to finding the equation of φ? What evaluation was performed for the number of 1 / φ? How compare the result with information about the logarithmic spiral?

In the appendix we describe some materials for the mathematical teaching approach of recurrences, meaning class activity guitar and its measurements, the domestic rabbits' problem and also an evaluation test.

References

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