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20. MATHEMATICAL DEDUCTIONS AND POETRY, MUSICAL INSTRUMENTS IN SECONDARY SCHOOL

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Abstract: *We will present a method by which, during music education class, students can be presented, clarified, and fixed with elements of music theory and music-poetry connections, all starting from the virtual piano and guitar, applications currently accessible to anyone, anytime.*
Key words: *deduction, body percussion, musical and poetic meter*

1. Introduction

The virtual piano has both the name of the keys and letters on them, the actuation of which from the keyboard has the sound effect of striking the corresponding key.

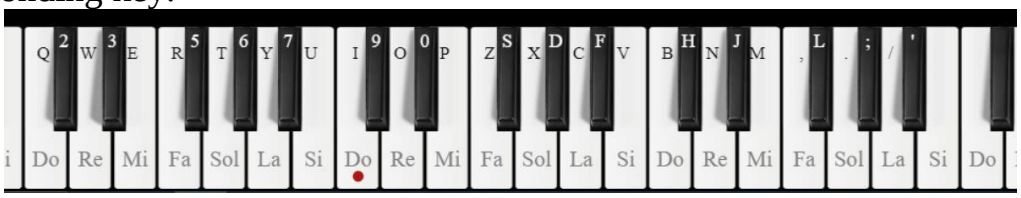

Fig. 1 Virtual piano keyboard

This detail of the application is a starting point for the music education lesson, on the one hand fascinating children with the accuracy and beauty of the sounds generated by "typing on the keyboard" and on the other hand giving them the chance to begin studying music methodically, with an openness to the strong ideas of music theory, similar to vocational schools. If in the virtual piano we started from letters to music, in the virtual guitar we will start from numbers to music, numbers naturally attached to the frets and giving, by subtraction, the number of semitones in any musical interval with both ends played on the same string.

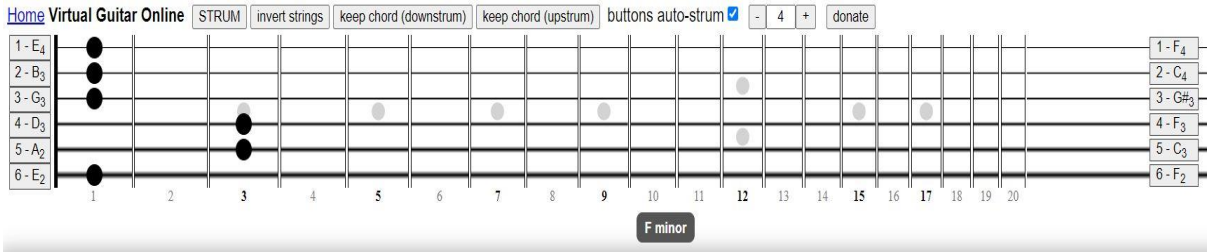

Fig. 2 Virtual guitar keyboard with associated numbers for orientation

The reciprocal of these steps to know musical intervals is their recognition, implicitly the number of semitones, therefore "measuring by ear the segments (on the strings)"[112], formulations that constructively thrill children. Fixing the intonation gives the freedom to deepen the rhythmic aspects, a dimension in which mathematical rigor will be a catalytic factor in understanding and dismantling the formulas, its order extending into the concreteness of musical interpretation through small elements of body percussion, percussion that will give the musical interpretation in the group extra warmth and coordination.

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[112] We notice that we can also look at the virtual guitar as a system of six axes of natural numbers (axes segments), musical education becoming a mental and emotional stimulus for algebra class, a class in which only one axis is worked on!

The interiorization of the melody, entering into its heart, literally brings poetry, the melody becoming concrete, familiar almost like speaking, calling for new texts, in order to fulfill expressiveness. Because both melody and poetry spring from the soul, compatibilities are often cascaded, for example, with a fragment of Mozart's Lacrimosa are compatible lyrics by Lucian Blaga, Mihai Eminescu, George Topârceanu, etc.

2. Stages of the method

We will present the steps of the method, each time attaching a concrete example starting from either a fragment from *Doina olteanului*[113] or from a fragment from the *Lacrimosa-Requiem* section by Wolfgang Amadeus Mozart[114]:

1. Starting from the score of the song to be studied, the teacher writes on the board the letters and numbers[115] on the virtual piano keyboard, letters on the keys of the notes in the identified melodic lines/motifs. The children, surprised, will want to check the symbol codes, noting that by operating the keyboard the computer generates, sound by sound, motifs from the song studied.

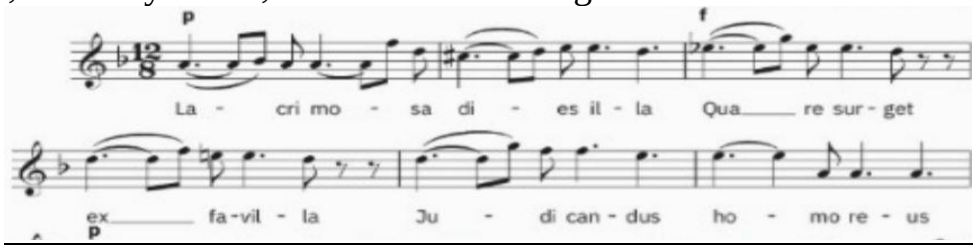

Fig. 3 Fragment *Lacrimosa* by W. A. Mozart

Re Sol Fa Fa Mi Mi la la la

For this fragment, the codes are:[116] CFCC, NHNMMN, J.JJNN, MMN, N., MMCCC, codes that strictly resolve the intonation, for the rhythm following other procedures.

2. The codes already having auditory consistency,[117] we proceed to their translation into musical note names, each symbol on the keyboard being associated, according to the keyboard, with the defining note. The children determined, in a way starting from the sonority, the names of the notes in the score, our approach also fixing them with the intonation and recognition of the notes.[118] We exemplify with the previous codes, under each code being the corresponding names of the notes:

CFCC, NHNMMN

La sib la la Fa Re Do# Re Mi Mi Re

J.JJNN,MMN

Mib Sol Mib Mib Re Re Fa Mi Mi Re

N.,,MMCCC

Re Sol Fa Fa Mi Mi la la la

[113] Lăcrămioara Ana Pauliuc, Loredana Streche, *Educație muzicală clasa a VII-a*, Editura Ars Libri, București, 2024

[114] Mariana Magdalena Comăniță, Magda Nicoleta Bădău, Mirela Matei, *Educație muzicală clasa a VIII-a*, ArtKlett Publishing house, București, 2020

[115] In a word keyboard symbols.

[116] By pressing the comma (the key corresponding to the comma) on the keyboard, the computer will emit the sound fa from the 2nd octave, by pressing the period (the key corresponding to the period) on the keyboard, the computer will emit the sound sol from the 2nd octave

[117] In all classes, the children really want to "sing on the computer", so each code is sung several times, implicitly fixing the intonation.

[118] Recognition that often involves silences filled with endless counting of the lines of the musical score, silences inappropriate for the only musical education hour in the weekly schedule.

3. Having the names of the notes, one more surprise can be added to the lesson, the teacher writing on the board the fret numbers of the notes in each motif/melodic line of the piece, the idea being to sing everything on the same chord, this variant being, on the one hand, more accessible to children when playing on the computer[119] and on the other hand indicating for each musical interval involved the number of internal semitones. Let's exemplify with the numbers associated with the previous codes, the chord used being Sol/G:

2 3 2 210 7 6 7 9 9 7
8 12 8 8 7 7 10 9 9 7
7 12 10 10 9 9 2 2 2

4. Above the names of the notes determined using the virtual piano, [120] the corresponding rhythmic durations are written, followed by the rhythmic reading of the respective names in a group. We exemplify with a fragment from *Doina olteanului*[121].

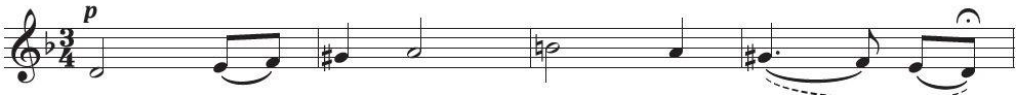

Fig. 1. Fragment from *Doina olteanului*

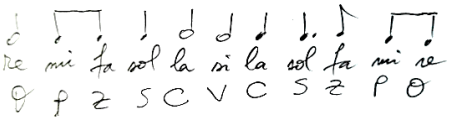

Fig. 2. "Dismantling/explaining" the fragment

In order to become more aware of the rhythm, a discreet element of body percussion can be proposed to children, namely the marking, in this case,[122] of the two eighths of the fourths involved, the first eighth with the thumb, the second with the index finger, the support of these light beats being the palm of the other hand. The rhythm will be felt in both hands, giving concreteness to the singing, precision and coordination. This elementary variant of body percussion can also be used as a support for studying rhythmic formulas, independently of note names, intonation, etc. The "manual metronome" will pulse the subdivisions of time, on this geometric precision the formula is spoken orally.

We specify that students can arrive on their own, through play, at the idea of syncopation, starting from a simple rhythmic motif, 2 fourths followed by 2 or 4 eighths and proposing to them the permutation of fourths and eighths. After 4 or 5 permutations, at least one syncope will surely occur, the new toy being easily dismantled, based on previously acquired reflexes.

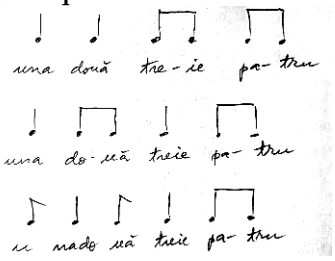

Fig. 3. Syncope found by children through permutations fixing rhythmic skills

[119] Constantly following and singing on the chord axis, considering the numbers specified for the motif/melodic line.
[120] Names that were not arrived at by counting lines and staff spaces in furious silence, but, paradoxically, by going through notated music.
[121] Lăcrămioara Ana Pauliuc, Loredana Streche, *Educație muzicală clasa a VII-a*, Editura Ars Libri, București, 2024, p. 27
[122] For the triplet, the middle finger will also be used, for the group of sixteenths, the ring finger.

We also exemplify with apparently more complicated rhythmic formulas, formulas extracted from Lacrimosa previously studied from the perspective of intonation.

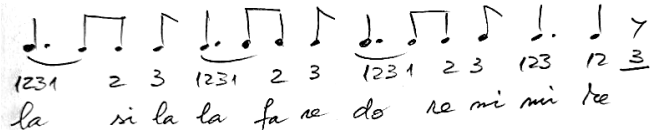

Fig. 4. Lacrimosa rhythm disassembly

The numbers indicate oral counting, the names of the notes, the oral rhythmic reading. Initially, the numbers corresponding to the subdivisions of the fourths will be spoken, for fixation, followed by reading the names of the notes on the fixed rhythm and eventually intoning the transposition of the melody a minor sixth lower, a transposition obtained elementary by moving from the G chord to the B chord and singing the same numbers specified for the G chord.

3. Poetry and the efficiency of mathematical deduction

We will exemplify this with two contexts of elementary mathematics but having implications in basic music theory, one starting from children's reflexes to reason starting from clear and simple figures, the other concretizing mathematically and musically the notion of permutation. Accustomed to mathematics and physics with axes, children will see them here in full regalia, the colors of the sounds on the strings.

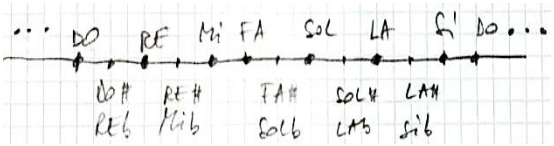

Fig. 5. Segment of the guitar string axis

Starting from this "geography of a string", children will deduce many decompositions of intervals, discovering a world of expressiveness. For example, for the perfect fourth, identifiable with the number of semitones 5, the tonal decompositions in the tempered system are 221, 212, 122, the children deducing for a starting note, chosen by them, the notes of each decomposition. The small geometric exercise stimulating their thinking and attention, the vocal intonation after playing on the virtual guitar will improve their intonation, refine their expressiveness and open the door to the warm, beautiful side of the present, of the moment.

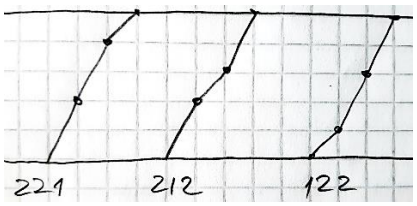

Fig. 6. Perfect fourth tonal decomposition

The 5th grade curriculum proposes the keys C major and A minor, the 6th grade curriculum proposes the keys G major, E minor, F major, D minor. In line with this, the virtual guitar app proposes major, minor, and dominant seventh chords, all at the touch of a button.

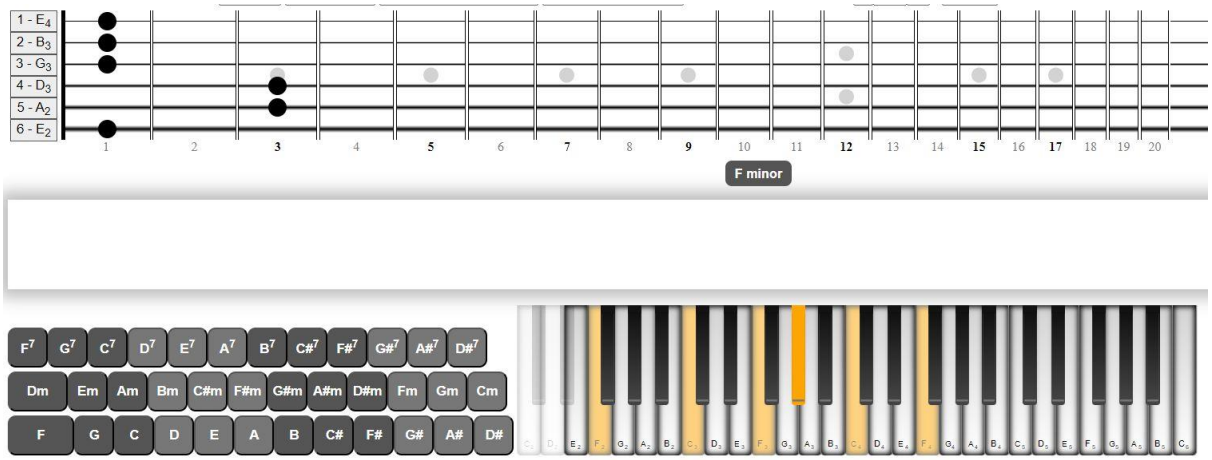

Fig. 7. Virtual guitar chords associated with keys

The chords on the virtual guitar will allow children to feel the atmosphere of the tonalities, for this they have to deduce/count which are the steps I, V (possibly V7) of the tonality. Knowing that:

- the step I of the major has the formula 4 3 relative to semitones, the children will deduce its component notes (actually the steps I, III, V of the tonality). By pressing the key corresponding to the chord, the chord located on row 3 in the table on the virtual guitar, the computer will generate the sound and indicate on the fretboard the keys accessed, the notes corresponding to these keys being easily deduced using the chord axis or using the guitar map.

MI	fa		sol		la		si	do		re		mi
SI	do		re		mi	fa		sol		la		si
SOL		la		si	do		re		mi	fa		sol
RE		mi	fa		sol		la		si	do		re
LA		si	do		re		mi	fa		sol		la
MI	fa		sol		la		si	do		re		mi

Fig. 8. Guitar map

For example, for the F major chord, the component notes fa (E2[123]), do (A2), fa (D3), la (G3), do (B3), fa (E4) will be deduced. To take the tone, respectively intonation of the associated arpeggio, either the attached piano or the guitar can be used, internalizing the sonority allowing adaptation for the voice:

- the I degree in minor has the formula 3 4 and is treated similarly, all minor chords being on row 2 in the virtual guitar chord table,
- the V7th degree in all keys has the formula 4 3 3, is treated similarly and has row 1 reserved in the virtual guitar table.

You can do exercises on permutations of the component notes of the chords,[124] followed by playing on the virtual piano, on the virtual guitar on a chord[125] and vocal intonation. We illustrate this with a few permutations in a general context, with the concrete notes being replaced by the name of their function in the chord, fundamental, third, fifth, seventh.

[123] In parentheses are the corresponding strings.
[124] You can also work from reversals, but we will refer to them.
[125] For simplicity, mathematical deduction is required here to determine which chord the permutation arpeggio fits into.

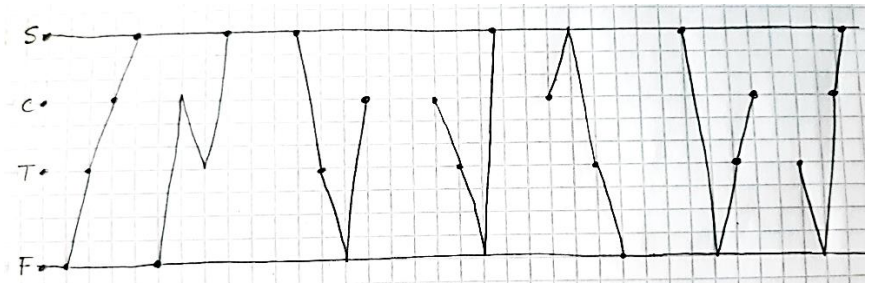

Fig. 9. Dominant seventh permutations

4. Some rainbows of the music-poetry connection

The core of the compatibility of a melody with a group of verses is first of all the similarity at the level of meter, on the one hand musically, on the other poetically, to this organically added the convergence of expressiveness, of the states of mind brought into concrete. We will exemplify this starting from a fragment of Lacrimosa-Requiem by Wofgang Amadeus Mozart, a fragment present in the 8th grade music education textbook.[126] The musical meter requires at first glance a verse of 8 syllables, a succession of trochee metrical feet. It can be sung on stanzas or groups of verses from the poems:[127]

- *Doina, Peste vârfuri, Scrisori I-III* byMihai Eminescu,
- *Suflete, prund de păcate* by Lucian Blaga
- *Balada morții, Balada munților, Rapsodii de toamnă* by George Topârceanu, ach choice of lyrics revealing other facets of the expressiveness of the melody. Since the Mozartian fragment requires 5 verses, the last one concluding in a positive register, as is the melody, children will have the opportunity here to make motivated selections with the clarity of intuition, both objectively and subjectively with generality.

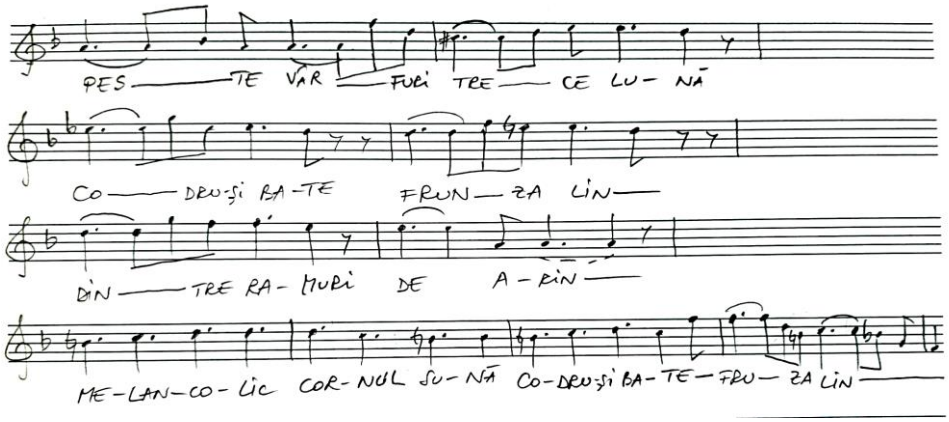

Fig. 10 *Lacrimosa* by W. A. Mozart și *Peste vârfuri* by M. Eminescu

The respective poems have (groups of)[128] verses compatible with melodies in the Romanian register, stylized folklore. We refer to Doina olteanului and Doină by George Ștefănescu, pieces present in a 7th grade music education textbook,[129] all of these, the Mozart-poetry-doine connections, proving once again that the human soul has its depths, scopes and heights always the same, anywhere, anytime.

[126] Mariana Magdalena Comăniță, Magda Nicoleta Bădău, Mirela Matei, *Educație muzicală clasa a VIII-a*, Editura ArtKlett, București, 2020, p. 17
[127] For example.
[128] Possibly the poem in its entirety.
[129]Lăcrămioara Ana Pauliuc, Loredana Streche, *Educație muzicală clasa a VII-a*, Editura Ars Libri, București, 2024

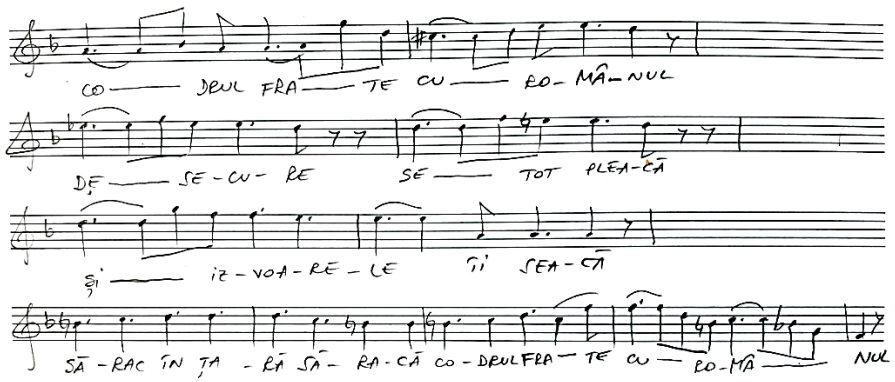

Fig. 11. *Lacrimosa* by W. A. Mozart and *Doina* by M. Eminescu

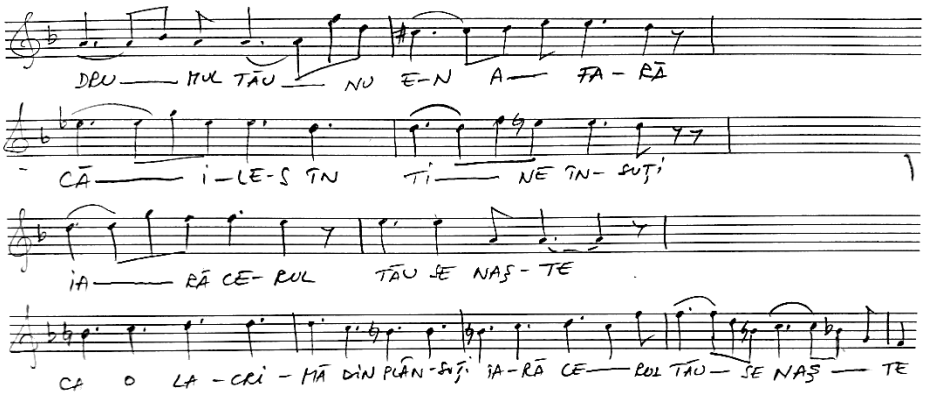

Fig. 12. *Lacrimosa* by*W. A.* Mozart and *Suflete, prund de păcate* by L. Blaga

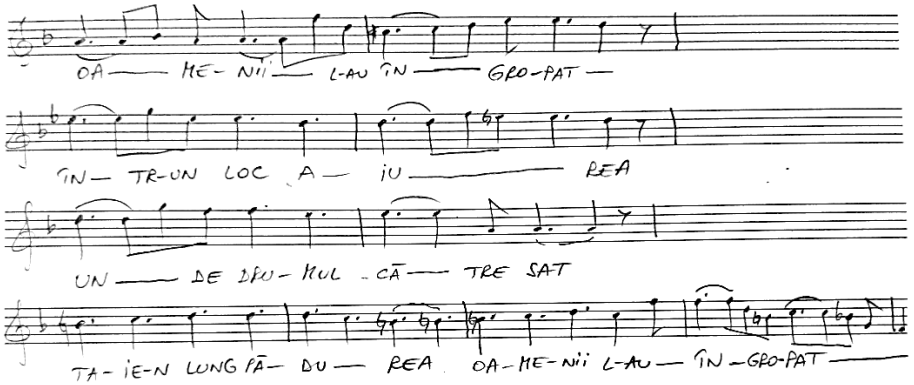

Fig. 13. *Lacrimosa* by W. A. Mozart and *Balada morţii* by G. Topârceanu

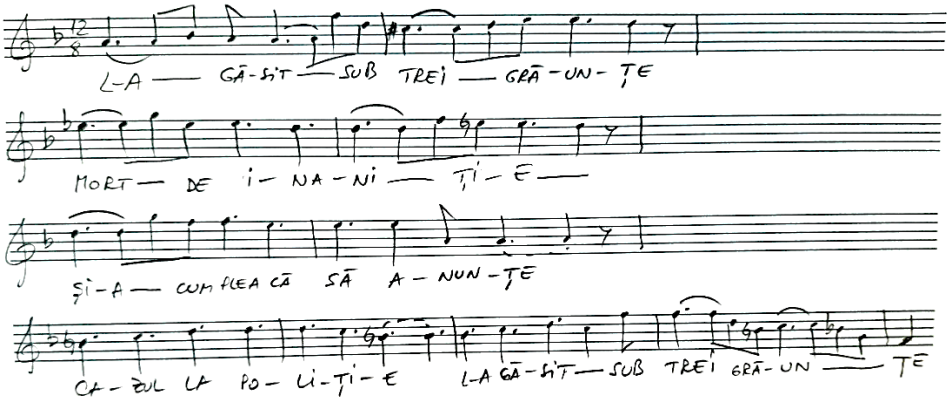

Fig. 14. *Lacrimosa* by W. A. Mozart and *Rapsodii de toamnă* by G. Topârceanu

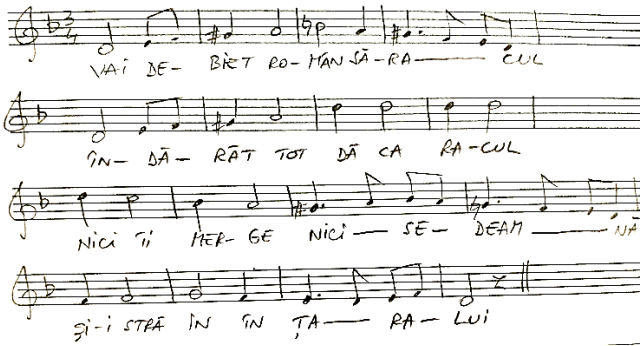

Fig. 15. *Doina olteanului* and selections *Doina by M.* Eminescu

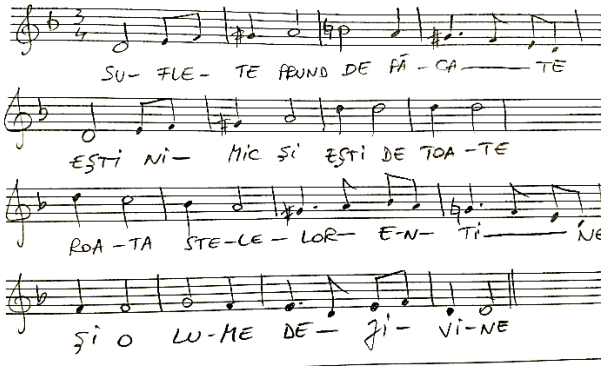

Fig. 16. *Doina olteanului* and *Suflete, prund de păcate* by L. Blaga

5. Conclusions

Because music is both precision and sensitivity, immaterial, just like a flight, the only one allowed to man anywhere, anytime, approaching music education classes from the perspective of the music-mathematics-poetry connection gives children access to the core of music theory, nodal points for the coagulation of understanding and a way to express and encompass[130] some tenderness or tensions of the soul, some moments in life/daily with a lot of meaning, with a lot of implicit infinity.

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3. Lăcrămioara Ana Pauliuc, Loredana Streche, *Educație muzicală clasa a VII-a*, Ars Libri Publishing house, București, 2024

[130] Through listening, recognizing your own feelings in the piece you listen to.