***Digital Key in Elementary Music Education***

In pedagogical practice at the first stage of musical teaching the natural abilities of children were always taken into consideration, it is the main principle on which the pedagogical process is based.The child’s psycho-emotional status and neurophysiologic peculiarities of mechanisms of brain’s activity (perception of the information from the sheet, analysis and syntheses of the perceived pattern, realization of the neuro-motor function of hands on the keyboard of an instrument ) were not taken into consideration in due measure.

It is known the difficulties in perception of any information, including musical one, cause strain of the main functional systems in the child’s body. Statistics and practice show that period of learning with standard music grammar is pulled for several years. At early stage of teaching up to thirty percent of children lose their interest to music subject and leave study. This situation is explained by the excessive load arising at the first contact of the child with a complex format to play a piano.

In order to protect the health of parents and children ,in response to COVID-19, Neuromusic Lab Reflection proposes to replace face-to-face music training with distance teaching. We would like to share a technological resource that can both reduce the risk of severe disease and simplify the methods of music teaching for beginners .The above should not be understood as a rejection of generally accepted music training in the classrooms but to protect the health of children and adolescents, online teaching technology will be effective and successful. Integrated Music Teaching through digital format gives an positive result regardless of the platform both interactive and online lessons.

**Physiologic Base**

The physiological substantiation on application of the Digital Key for coding and decoding of a melody is the following : children begin their contact with digits already in preschool age, when they are taught to count and this system is learned by children quite firmly, since it is often used in their daily life at every step. But the generally accepted music grammar is new for them and, naturally, requires some additional period of time to be acquired by children. It is for that reason that in the initial period of musical teaching, children inevitably spend a lot of time and efforts to read a melody written down in music signs. Naturally, it slows down rate of training, causes psycho-emotional discomfort, lowers the child’s interest to music. Therefore, in the initial period of teaching, besides work with the generally accepted music grammar, it will be useful to substitute it with the use of a digital system for some time. It does not mean that we want to do without standard music grammar but at the initial stages of musical education, the system of digital coding and decoding of music sounds is undoubtedly useful since it speeds up teaching of children.

**Parallel Description**

In practical work, while reading the generally accepted music information from sheet, the direction of eyeballs’ movements is spasmodic, it has a multi-stage combination both on y – vertical, from the G-key up to the F-key, and on x- horizontal often with return of eyesight to the initial point. For integration, synthesis and the modification of complex pattern of the received information the structures of the central nervous system require an additional period of time. It is a neurophysiologic process proceeding in an interval of time between the moment of perception of the music information from sheet and the moment of the hands’ response on the keyboard of an instrument. A great number of irregular nervous impulses is transferred to the central nervous system per unit of time and, as the consequence of this, fatigue of hand muscles is considerably increased.An amplitude of muscle tension is directly dependent on the stimulation frequency, when each subsequent nervous impulse coincides with the phase of increased excitability of a muscle. On the level of synaptic terminal we can see untimely synthesis of neurotransmitter, deep and stable depolarization of postsynaptic membrane and, as a result, the convulsive reflexes are thus formed. An important neurophysiologic moment has been noted : during a short time interval the contracture, i.e., constantly high muscular tension is formed, that in turn, is harmfully reflected on the contents and character of a melody.

In practical work while reading the digital information from sheet the trajectory of eyeballs’ movements on y–vertical is projected to the exact determinant ( digit, sign, symbol ), the trajectory of eyeballs’ movements on x – horizontal is projected in one direction, ahead. In the given system of dimension the integration of the digital information proceeds instantly, its realization on an instrument proceeds in reflexive time-ratio. The paradoxical phenomenon is revealed : the interval of time, between the moment of perception of the digital information from sheet and the moment of the hands’ response on the keyboard of an instrument, is contracted to a minimum. We achieve a reduction of load on hand muscles at the expense of decreasing of an amplitude between muscle tension and the resulting movement and, as a consequence of this, the time intervals between effort and accuracy of pressing of a key are considerably shortened. An important neurophysiologic moment has been noted: reciprocal muscular innervations is formed, i. e. the rational distribution of the manual technique on the keyboard of an instrument, that in turn, is considerably reflected on the contents and character of the melody.

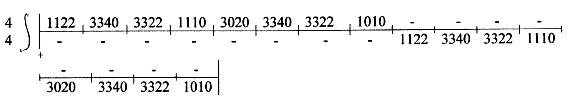
**Neurophysiologic** **Aspect**

Dynamics of movements and actions is characterized by time, high-speed, spatially-time, power and other parameters. Given parameters reflect the complex neurophysiologic processes passing in leading functional systems of the child’s organism ( central nervous system, muscular system, and others ) also explain, from a scientific point of view, the interrelations of neuromuscular coordination in their kinetic and dynamic data, the appearing threshold potential of synapse fatigue, interrelations between the frequency and intensity of nervous impulses. Fatigue of synapse is explained by extra continuous excitation in result of which a considerable quantity of neurotransmitter is allocated, naturally, this leads to untimely synthesis and, as a result of this reaction, the progressive increasing amplitude of postsynaptic potential of action is formed. Partial delay of synaptic transmission violates the functional activity between muscle tension and the resulting action of manual techniques, therefore the child’s acoustic analyzers perceive consecutive or separated codes of deformed music information in time, rhythm and sound expression, of course, this violates the coordination of music-acoustic interrelations, leads to the defect of metro-rhythmic functions, restrains the development of child’s natural musical abilities. While applying the technology of Digital Key, the child rationally distributes the total study load on leading functional systems his organism, creates highly - accurate coordination without inclusion in practical activity of unnecessary muscle groups, unnecessary movements, excessive effort by pressing a key, and it means, he excludes possibility of appearing of false acoustic and muscular sensations, and as a result of it, instantly creates a firm neuron code in his brain, which in our life we call as a skill of coordinated action. The Project "Reflection " is aimed at studying the somatosensory integration of nerve signals in the main functional systems of the child’s organism : the central nervous system, auditory ,muscular , visual , using electrophysiology measurement techniques - ENG, EMG,EEG, Audiometry. Method EEG allows to research the difference of the integrated synaptic signals , to make the comparative diagrams of dynamics of initiated spikes while perception music metric and digital patterns, plus the time of fatigue of synaptic structures and cells - neurons of cortex is determined . Method ENG - EMG completes one another, joints the visual analyzer with the neuro-motorfunction of fingers and proves , from scientific point of view , the development of muscular fatigue in hands depending on the quantity of eyeballs’ fluctuations. Method Audiometry allows to research the increment of sensitivity to the functional sounds ( pure-tone ,high - low pitched, brain waves, beta range) plus the behavioral audiometry.

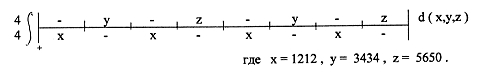
Realization of the described scientific investigations in this direction will allow us to approach closer to understanding of more subtle mechanisms of child’s mental activity and to detect physiological factors that promote to improvement of quality, speed and efficiency of elementary music teaching .

**Mathematical Aspect**

The study module includes the integration of entire music structure by means of digits , fraction : the information in numerator – right hand, information in denominator – left hand.

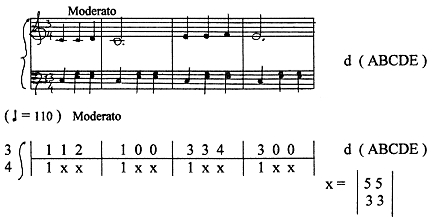


Repetitions of motifs and integrity of these segments should to be code through variable mathematical values or symbols ( x, y, z ). That way of cording simplifies the pattern for visual perception and it allows the child faster to do analyses and synthesis of a melody as a whole.



The digital marking of a chord with the help of a matrix and expression through

the determinant allows to create a visual – motor stereotype of perception of a chord as a composed element of music structure.



The matrix mode considerably simplifies the work with accompaniment, frees the child of great volume of difficult and tiresome work. The clear and simple interpretation of the music information through an integral key enables the child to make up a correct mental notion about the contents and character of the music play.

**Methodical Recommendations**

At the primary stage of music teaching a child stabilizes the metro-rhythmic functions comparing sounding of short and long sounds. It is logical to exclude difficult durations as the sixteenth and the eighth. Accepting the quarter note as the basic unit of measure, it is easy to explain half and whole durations using a way of addition. Stability of durations in simple form of division is easily perceived by children and promotes to preserving of an even rhythm.

Numeric Cognition

3345, 5432, 1123, 3020, 3345, 5432, 1123, 2010.       Ode to Joy  Ludvig van Bethoven

3330, 3330, 3512, 3000, 4444, 4333, 3223, 2050, 3330, 3330, 3512, 3000, 4444, 4333, 3554, 2010 .       Jingle Bells

For the natural time organization of metro-rhythm and expressive sounding of a melody it is required to change only tempo of the play, but the code of the melody should be recorded by means of relative durations. While acquainting with difficult durations, when pupil’s manual technique allows to use them, the melody written in quarters and halves should be performed in fast tempo Allegro, Presto ( ! = 180-208 ) naturally, we obtain the complicated type of durations as the sixteenth and the eighth. The counting as a means of organization of metro-rhythmic functions ,it is necessary to use in its active form : ta ta ti-ti ta ta , tika - tika ta ta and so on. Such way allows the child to graduate precisely a longitude of one vowel sound to relation to one beat. Fingerings is used in accordance with the teacher’s personal experience, and also with account of the child’s individual peculiarities ( age factor, motor functions, the long of fingers ). It is not necessary to write out the fingerings in all music piece in detail, the most rational is fragment marking of fingerings in technically difficult and key places of the melody. In the method of Digital Key it is necessary to use the letter fingerings :“ t “-thumb,“ i “-index, “ m “- medium,“ r “-nameless, ” l “- little finger. At the third stage of teaching while transition to the forms traditional music letter the breakage of the formed stereotype doesn't cause efforts and difficulties as the child already freely owns digital base of coded music-acoustic skills , besides it , the algorithm is designed in such manner that solves this moment of transition, naturally, psycho-emotional self - affirmation of the child requires purposeful activity in studying of standard music format.

**Summary**

The scientific article “ Digital  Key in Elementary Music Education “ raises the topic on the necessity to use of the digital technology in the system of stage by stage music education. The main positive feature of the methods Digital Key is that it does not deny the generally accepted music grammar, and is as an additional material in the initial period of the child’s contact with music. The integratedmethod of music teaching is directed on the balanced and rational distribution of the sum study load to psycho-emotional sphere of a child and can be applied with success in the teaching with aid of computer and MIDI–technology. The scientific research entitled Reflection is closely connected with related sciences , pedagogy and medicine , requires support and realization of the neurophysiologic tests in accordance with the elaborated Project. <http://reflectionmusic.ucoz.com/> NeuromusicLab Reflection Ukraine

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