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## **Music Computer Technologies in Teaching Children with Profound Visual Impairment: Peculiarities, Problems and Perspectives\***

The article analyzes the processes of information, transforming the educational environment of children with profound visual impairment. It emphasizes the need for changes in the content of musical education in connection with the use of specialized software and hardware, digital educational resources.

The features of the process of teaching music using musical computer technology for blind people, which is due, in particular, the complexity of the complex psychological reactions of people with profound disabilities.

### Keywords:

information technology in education,  
music computer technologies,  
computer musical work,  
inclusive education, music education,  
pupil with deep visual impairments.

## **Музыкально-компьютерные технологии в обучении слепых и слабовидящих детей: особенности, проблемы и перспективы\*\***

В статье анализируются информационные процессы, трансформирующие учебную среду детей с нарушениями зрения. Подчёркивается необходимость изменения содержания музыкального образования в связи с использованием специализированного программного и аппаратного обеспечения, цифровых образовательных ресурсов. Рассмотрены особенности процесса обучения музыке с применением музыкально-компьютерных технологий для слепых, которые обусловлены, в частности, сложным комплексом психологических реакций людей с глубокими нарушениями.

### Ключевые слова:

информационные технологии  
в образовании, музыкально-компьютерные  
технологии, музыкальный компьютер,  
инклюзивное образование,  
учащиеся с нарушениями зрения.

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## Introduction

The analysis of the peculiarities of using of music computer technologies (MCT) [3; 7] by students with profound visual impairment showed that at present, in the training of blind people, MCT are used mainly in the field of secondary and higher professional education. On the one hand, this is due to the psychological characteristics of the development of MCT-programs by blind musicians, and on the other hand, with the system of music education in general. For example, in many colleges and universities, along with traditional disciplines, there are special subjects in which students master the MCT in their various manifestations. When teaching students with profound visual impairment, a sufficiently serious material and technical base are necessary, since blind students can study only with the use of specialized licensed equipment. Some non-specialized educational institutions, where students with profound visual impairment also successfully receive education, also have technical capabilities of an appropriate level. One of the leading Russian universities, actively engaged in the problems of teaching MCT to blind students, is the Herzen State Pedagogical University of Russia, in particular, educational and methodical laboratory “Music Computer Technologies”, on the basis of which many blind musicians of St. Petersburg have mastered the course of MCT [8; 9; 10;].

In children’s musical schools for pupils with profound visual impairment at the moment these items are absent. This is due to a number of reasons: a low level of knowledge of the basic skills of the PC user by blind students; lack of material and technical conditions; lack of qualified specialists in this field, etc. Among the main

issues that methodologists dealing with the problems of teaching music to children with profound visual impairment the following may be found: training multimedia computer and features of its implementation in the classroom with children with profound impairment; MCT as an instrument for creating music collections and textbooks for children with profound visual impairment; the use of the communicative possibilities of computer music (MC) [4; 5; 6] when teaching children with profound visual impairment; creative and cognitive capabilities of MC and the specifics of their use in teaching children with profound visual impairment; the role of notation editing program in music classes for children with profound visual impairment: the main problems and ways to solve them. Let us dwell on the elucidation of these problems.

## **Peculiarities of Realization of the Educational Functions of Multimedia Computer in the Classes for Children with Visually Impairment**

Computer training for blind and profound visual impaired children music has clear advantages: complexity, integration, possibility of repetition of the material to the stage of automaticity (training), etc. It is possible to implement largely music theory disciplines with computer learning. These include, first of all, musical literature, solfeggio, as well as musical notation on the Braille system — a special subject that exists in most specialized children’s musical schools and music classes for blind and visually impaired children, aimed at a comprehensive study of Braille notation. Introduction to the curriculum of this discipline is due to the fact that the relief-point notation, which is used by blind musicians (created in the middle of



the 19th century by the French teacher Louis Braille and is constantly being improved), is objectively more difficult for the perception of the child than the usual (flat-printed) notation system.

However, it should be noted that, despite the high efficiency of accessibility, training programs with the systematic use of MCT are currently not implemented or used in a fragmented, not systematic way in the field of music education of children with profound visual impairment. The current situation is largely due to objective reasons. Thus, the majority of specialized children's musical schools and music classes for blind and visually impaired children work on the territory of boarding schools, where students with profound visual impairment receive General secondary education. The curriculum of correctional schools provides both General subjects included in the educational standard of the Russian Federation (the Russian language, Literature, Mathematics, History, Geography, etc.) and specialized correctional disciplines necessary for the successful rehabilitation and socialization of blind pupils (social orientation, orientation in space, correction of motor disorders, the development of fine motor skills, the development of visual perception, etc.). In schools of this type until the 9th grade, when computer science is introduced, there is no special subject aimed at the study of multimedia computer and the acquisition of basic user skills.

The problem also lies in the fact that modern multimedia computer is focused mainly on the graphical perception of information. For example, a child with normal vision in the picture (label) can clearly imagine what you need a certain program, using a computer mouse to select the desired program and enter it. However, to open the same program using the keyboard, you need to have special knowledge related to the use of screen access programs such as "JAWS" or "NVDA", Braille displays, etc. To master the basic skills of working with multimedia computer, a blind child needs a

specialist who can competently teach him/her the basic principles of communicating with a "talking" computer. This is due to the low level of multimedia computer skills of pupils with profound visual impairment in primary and secondary level classes at the children's musical schools. If the child does not know how to work with computers, it seems inappropriate to teach him/her complex structure and features of the application of MCT-programs, and special disciplines for the development of basic skills of the PC user in the children's musical schools is not provided. In addition, in the context of constantly developing innovative technologies, qualified specialists who understand various aspects of this issue are needed. However, currently the number of professionals in this field is quite limited.

In order to understand better the current situation, attention must be paid to an important feature of the system of inclusive music education in the education of children with profound visual impairment. This category of pupils mostly does not go to ordinary children's musical schools and children's schools of arts, but to the specialized musical schools and musical classes. These classes are branches of the district, city and municipal children's musical schools and children's schools of arts, situated in the territory of boarding schools for blind and visually impaired children.

Blind musicians are being included in the educational process on a par with the sighted musicians mainly at the stage of training in music colleges and universities.

Musicians with visual impairments use relief-point notation, so at the initial stage of training they need special conditions for the comprehensive development of musical notation on the Braille system. As a rule, study of Braille notation is not provided in the curricula of the ordinary children's musical schools and boarding schools. Teachers who do not work systematically with blind students, cannot and should not hold the Braille music symbols. Therefore, teaching music for children with profound visual

impairment occurs mainly in specialized children's musical schools.

Thus, the teaching of blind children of the MCT-programs in the children's musical schools for blind and visually impaired pupils is currently not systematic. However, when working with pupils with profound visual impairment, it is possible and even necessary to apply the MCT in various forms. The use of MCT should be dosed, timely and proportionate to the capabilities of students. It should also be taken into account the fact that the MCT helps in the implementation of an individual approach to each child, because he has the opportunity to adjust some of the parameters of training, making them the most optimal for a particular situation. At first, this happens with the active participation of the teacher, and in the future the student becomes able to carry out all the settings on their own. The use of MCT increases pupils' motivation to learn a particular subject. They have a desire to overcome the difficulties encountered in learning and achieve the best results.

### **MCT as an Instrument for Creating Music Collections and Textbooks for Children with Visual Impairment**

Owing to the use of various information resources, it becomes possible to select more interesting material, exchange new materials with pupils, maintain contact with children's parents and with the children themselves, as well as create a variety of textbooks, etc. The latter direction is of particular importance in teaching music to children with profound visual impairment.

As already noted, the blind musicians when writing music use a special relief point Braille font. The same type is used in all spheres of written activity of people with profound visual impairment — in Mathematics, Physics, Chemistry, in various fields of Humanities, etc. However, the most fundamental differences from the usual (flat-printed) type are observed in the Braille notation system.

It is difficult for the blind to use the notes. They are caught, as well as letters, relief, and the tones are designated by separate signs and put in a row, as the lines of the book. For indicating the tones connected in a chord, the exclamation marks are being put between them. It is clear that the blind have to memorize them, though separately for each hand. So it is a very difficult job. Memorizing a few chords for each hand, you can sit down at the piano, and then from the connection of these convex hieroglyphs are composed of harmonious harmonies. In this case, there were too many intermediate processes between the play depicted on paper and its performance. While the sign was embodied in the melody, he had to go through the hands to gain a foothold in the memory and then make the return journey to the ends of the fingers playing.

Indeed, the Braille musical notation, on the one hand, allows adequately to display conventional (flat-printed) notes, with a fairly developed arsenal of symbols, however, on the other hand, it is significantly different from the latter. Analyzing the characteristic features of relief-point notation, affecting the perception of musical text: the lack of graphical display of pitch (each note in any octave is written the same, and only the octave sign indicates the position of a particular note on the keyboard, which makes it impossible to cover the direction of the melody as a whole); the linearity of the recording (all symbols are recorded in a certain sequence, sign by sign, which complicates the separation of the most important elements of the musical language from the secondary ones); the absence of a vertical in the recording (simultaneously the performed sounds are recorded with the help of special symbols, and the whole work is divided into fragments, in each them contains the recorded parties of the right and left hands are recorded in turn, which complicates the correlation of individual elements of the musical text). As a result, a blind musician who has read and played one note needs to spend considerable time





searching for the next one, often separated from the previous one by numerous signs. Therefore, a child with profound visual impairment spends enormously more time than a sighted student to read a musical passage and play it, and at first with different hands. It is not surprising that the complexity of this process at the initial stage of training causes many children display their unwillingness and even fear to play the notes, so that some blind pupils teachers begin to train them “off their hands by ear”. However, it seems indisputable that the development of musical notation is necessary for a musician as well as the knowledge of the usual literacy to every educated person: any beginner musician, including the blind, must possess a set of knowledge related to various musical notations, and be able to apply these notations in the main musical disciplines.

Mastering the relief-point notation is a very labour- and time-consuming process, requiring the introduction of a special subject in the curriculum, aimed at a comprehensive study of Braille notation. In the Saint Petersburg K. Grot Children’s Music School for Pupils with Impaired Vision (a branch of the Okhta Center of Aesthetic Education) in the classroom for musical notation pupils master the technology of musical notation relief-point font, develop and improve the skills of analysis and play with sheet music text. However, the study of theoretical material and especially its consolidation in practice is a serious problem, since the educational literature on this subject is practically absent. These features formed the basis of the system of visual-didactic tools, which includes adapted for students of different classes of musical examples, exercises and assignments on all topics of the course. We can say that the adaptation of musical notation is regarded as a kind of method that allows the child at the initial stage of learning to interact with the musical text, which is almost impossible in the analysis of unadapted Braille publications, as the level of knowledge of the student in

the initial period for objective reasons is quite limited.

Creation of music collections in the contemporary world is impossible without the use of note editing systems. This, of course, applies to the publication of notes in relief-point font. However, there are some technological features. It should be noted that in Russia at the present moment there are no MCT-programs that allow to adequately transcribe a flat-printed musical text into Braille. Therefore, the creation of music collections in relief-point type is a serious creative process that requires special knowledge and technical training.

Analyzing the printed music collections, published in relief-point font in different years, reveals two tendencies: on the one hand, to follow the printed analogue exactly, to the smallest details and footnotes (which often turns out as too complex explanation of simple music texts); on the other hand, a rather free handling of the musical text itself in order to make it “convenient” for the performance by a blind musician, that is, changes in the direction of facilitating textural presentation, arrangement of chords, octaves and often the melodic line itself. If the first method is quite competent in recording, but impossible in practical application for the initial stage of learning to play the instrument, then in the second case the need for such simplification is doubtful, since it inevitably violates the musical meaning of the work and the composer’s intention.

It seems obvious that to the senior classes of music schools each student must be able to play the music collections of almost any complexity of the recording, which is fully consistent with the printed analogue. Experience has shown that this goal can be successfully achieved through early reading and playing notes adapted to the level of knowledge of students at the moment of training. The teacher needs to offer the child notes with an accessible record, gradually forming a habit from the first steps to play on them, then in the future the ability to



work competently with the musical text will become the basis of creative independence of the blind musician and his professional growth.

After analyzing the music collections with adapted presentation of the Braille musical text, created since 2011 by the teachers of St. Petersburg Children's Musical School for Blind and Visually Impaired Children, we can come to the following conclusion: the use of MCT in the publication of both adapted Braille music collections and their flat-printed counterparts in helps to improve the quality of education of children with profound visual impairment, significantly expanding their repertoire capabilities.

On the other hand, it should be noted that modern MCT helps to optimize the educational process. Their application on music theory disciplines allows first of all to facilitate development and systematization of theoretical material as teachers have an opportunity to create and print out educational manuals on various subjects in a relief-point font. As a result, the time that was previously devoted to the recording of theoretical information can be used for more detailed practical study of the material under study. In 2013–2014 Anastasia Govorova, the teacher of the Saint Petersburg K. Grot Children's Music School for Pupils with Profound Visual Impairment (a branch of the Okhta Center for Aesthetic Education), managed to produce and test two musical notation textbooks — “Preparing for the Oral Transferring Exam on Musical Notation in the Braille System” and “A Crib for Musical Notation”.

It is also possible to create various teaching textbooks on musical literature (for example, textbooks in audio format) with the help of MCT. Thus, it becomes undoubted that the use of MCT for the creation of Braille music collections, their flat-printed analogues and teaching textbooks in theoretical disciplines plays an important role in teaching children with profound visual impairment, contributing to both the expansion of the repertoire of beginning blind musicians,

and the generalization and systematization of their theoretical knowledge.

### **The use of Communication Capabilities of MC in Teaching Children with Visually Impairment**

The possibilities of modern MC in the field of inclusive music education are presented in a number of works, including [1; 2; 11; 12]. The communicative functions of the MC are also most revealed in the Internet, the space of which serves primarily as a huge source of information of various types (in text, audio, and video formats), accessible through speech synthesizers for students with profound visual impairments. However, the search for information and its downloading are associated with certain technical difficulties for blind children and require special knowledge and skills, the development and formation of which many children have to pay close attention. In addition to text messages, you can transfer graphics, sound, animation files, music (in mp3 format), special literature and even videos. This allows the teacher to work with blind students to send them the information they need at the moment in the most optimal format for them. However, this method of communication is available mainly to students of middle and higher classes at children's musical schools that are usually already well able to work independently with the MC by this time.

The use of email helps to establish and maintain contact with parents of blind students. This aspect seems to be very significant, since many children, studying in the school, located on the territory of the boarding school for blind and visually impaired children, remain there for the whole school week. For classes of musical notation on the Braille system children are distributed in theoretical materials and teaching textbooks, printed in relief-point font. Many parents do not know the musical system of Braille, but strive to help their children in the development of this difficult

subject, especially in the early stages of training. Parents will be sent the relevant materials to plain text format. Systematic communication of the teacher with parents of blind students via email often facilitates the organization of the educational process, at the same time significantly increasing its effectiveness.

The ability to communicate online is also important. It is noteworthy that students with profound visual impairments are often psychologically more comfortable to ask a question not in person or by phone, but through chat, i.e., without entering into direct contact with the teacher. In addition, with the help of special equipment, the MC can work in a video mode, which allows you to communicate with students who, for example, could not attend a lesson due to illness. This makes it possible to explain the missing material and work it out in full volume — if necessary, even with the use of a musical instrument.

An important role is played by the fact that communication via the Internet allows you to expand the circle of communication of the young blind musician. For example, pupils of the Saint Petersburg K. Grot Children's Music School for Blind Children (a branch of the Okhta Center for Aesthetic Education) at the school actively participate in various festivals and competitions, in which they get acquainted with young musicians from different regions of Russia. These contacts are maintained and constantly expanded.

### **Creative and Cognitive Capabilities of MC and the Specifics of Their Use in Teaching Children with Visually Impairment**

The creative and cognitive capabilities of the modern MC are certainly extremely extensive. Let us dwell on some of them and consider the possibility of their use in music classes with children with profound visual impairment.

The cognitive possibilities of MC are quite large: listening to music, acquaintance with

special literature and fiction, watching movies, etc. All these possibilities play an important role in teaching music to blind children. However, it is particularly important for musicians with profound visual impairment to be able to play audio. Any modern MC, equipped with a sound card and a CD, allows you to listen to a regular CD, the sound of which can be impeccable, but it depends on the quality of the sound card and speakers. It should be noted that independent listening to CDs and music files in mp3 format with the help of computer media players is not particularly difficult even for children with profound visual impairment, since many of these programs work correctly with speech synthesizers. In addition, some drives may start automatically. Unlike music centers and portable audio players, MC allows the blind musician to get acquainted with the text information contained on the discs (for example, with the names of tracks, the names of artists, etc.).

With the advent of MC has acquired great importance of digital recording, the main advantages of which include low noise, signal immunity to interference and the possibility of flexible processing. Nowadays, the contemporary systems of sound processing and editing allow making MC a real audio studio, all operations at which are carried out, in contrast to the physical studio, programmatically. Audio editors allow making a professional sound cleaning, to provide it with special effects and to record the finished material on a CD. With the help of audio editors, you can make the recording surround sound, remove or add the upper or lower frequencies, shorten the file or insert a new fragment, save the file in a different format, clear of noise, etc. All these operations are performed using "effects" in real time (file processing occurs during listening to it) or in unreal time (first processing starts, and only then you can listen to the result. The most popular programs that provide extensive editing capabilities in this case



are audio editors Sony Sound Forge and Steinberg WaveLab.

With the help of MC it is possible to become engaged in graphics, animation, literary and scientific activities, including musicology. The latter direction is technically the most accessible for blind students of middle and high school. For example, abstracts, reports and other written works can be done at music literature lessons. At the same time, even if the student makes a Braille version for his/her own use, the teacher will be able to read and analyze the flat-printed version of the report created on the MC and printed with the help of a conventional printer. Therefore, we can say that the study of music literature has become a special subject area in which without additional hardware and special software it is possible to make full use of MCT as the blind pupils get the opportunity on a par with sighted to independently listen to the audio files to find information in text and audio format, write creative work, etc. Thus, at present, the concept can be fully implemented in music literature lessons.

Another area related to the creative possibilities of MC is the creation of music. Contemporary systems for creating computer music often combine the capabilities of recording and editing MIDI data and audio. Today, the most advanced software packages in this area are the audio MIDI sequencer Steinberg Cubase, audio MIDI mounting station Steinberg Nuendo, interactive sequencer Band-in-a-Box, etc. This sphere of musical computer creativity, of course, is of particular interest for musicians with profound visual impairments, as it opens up wide opportunities for them to create digital phonograms, arrangements and their own compositions. However, the development of programs of sequencers in music school for blind children currently fraught with considerable difficulties. For classes with children with profound visual impairment, additional technical devices are required: speech synthesizers and special scripts that make it possible to work with

some sequencers (for example, with the Sonar program). In addition, the creation of computer arrangements involves a serious base for theoretical knowledge in the field of harmony, composition and instrumentation, as well as sufficiently developed ideas about the musical form and a variety of styles that can be filled with the use of MCT-programs for special purposes. Taking into account the experience of using sequencers in teaching blind students of music colleges and universities, we can say that classes in musical computer creativity with children with profound visual impairment are possible under certain conditions: the presence of a computer class equipped with special equipment designed for practical use by children with profound visual impairment; the creation of a special subject aimed at the detailed development of various features of sequencer programs; development and testing of the curriculum on the subject, adapted to the perception of blind children. At the same time, it is necessary to keep in mind another important aspect, namely the problem of training qualified specialists in this field.

The introduction of this subject seems to be appropriate beginning from the 5th class, and it would be more optimal to introduce it in the 6th or 7th grades. This is due to the peculiarities of the educational process in the school for blind and visually impaired children, in which the main is a nine-year period of study. In grades 10–12 pre-vocational training programs are implemented, focused on the admission of blind students to music colleges and universities. It would also be useful for these programs to take a deeper look at the rich potential of MCT.

### **The Role of Systems of Musical Notation in Music Classes for Children with Visual Impairment: the Main Problems and Ways to Solve Them**

Mastering of systems of musical notation is one of the most important directions





in teaching profound visual impairment children with MCT. It has been repeatedly noted that blind musicians use a relief-point font when reading and writing musical notated music. At the same time, Braille notation is fundamentally different from the usual linearity of the recording and the lack of clarity. Therefore, a comprehensive knowledge of this system presents certain difficulties for teachers working in the school for children with impaired vision, not to mention the teachers who are sometimes faced with blind students in regular musical schools and boarding schools. In addition, if in specialized children's musical schools knowledge of relief-point notation is mandatory for all teachers, in most of children's musical schools in teaching children with profound visual impairment there are a number of problems, largely related to the development of the musical text.

Modern MCT is theoretically possible to solve this problem. However, currently in Russia the technical implementation of this direction is not possible. This is due to a set of factors, the first of which is the graphical basis of most modern music editors. Speech synthesizers, which are used by people with profound visual impairment when working with MC, can only voice information in text format. However, note set and editing work is not relevant to this area.

It should be noted that in some music editing systems (for example, the Sibelius music publishing editor) it is possible to enter music notations from a computer keyboard or using a MIDI keyboard. In this case, there is another problem: checking the correctness of the entered symbols. To control his actions blind musician can be done in two ways: using screen access (auditory control) and using the Braille display (tactile control). However, both options cannot be applied to work with music editors at the moment. Auditory control is not possible due to the fact that the information to be checked exists in a graphical format. The difficulty of implementing tactile control due to the fact

that the conversion of conventional musical text in Braille by software is currently not made.

Thus, there are two main problems associated with the possibility of mastering the note editing systems by children with profound visual impairment. On the one hand, the study of systems of musical notation seems promising for beginners among blind musicians, many of whom after graduating from a specialized children's musical schools come to conventional music colleges and universities, where the question of translating The Braille musical text in a flat, especially in the music theory disciplines (for example, writing down solfege dictations, school works in harmony, works on polyphony, etc.), gets quite acute. On the other hand, there are technical difficulties impeding the successful implementation of this direction. The solution to this problem can contribute to the development of special software that allows blind musicians not only to enter musical notation from a computer keyboard, but also to verify the information entered.

The process of introducing MCT in children's schools of arts and children's musical schools for blind and visually impaired pupil has already begun. This primarily refers to the implementation of educational, cognitive, creative and communicative capabilities of the MC. A significant role in the education of children with profound visual impairment is played by the use of MCT specifically for the creation of Braille adapted music collections and teaching textbooks on theoretical subjects, which contribute to a significant expansion of the playing repertoire of novice blind musicians, as well as the generalization and systematization of their theoretical knowledge.

The use of communication capabilities of MC contributes to the effectiveness of the educational process, at the same time significantly expanding the musical horizons of blind students, forming and strengthening their creative contacts.



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