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Music Computer Technologies and Interactive Systems of Education in Digital Age School

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***Abstract*—The development of music computer technologies in the late 20th – early 21st century has significantly expanded the ways of obtaining information. High-tech information educational environment requires the search for new approaches and fundamentally new systems of education in the School of the Digital Age. The global applicability of the music computer technologies (MCT) provides new, in fact, limitless possibilities of self-realization, stimulates the rapid development of intelligence, raising training to a new level. Compatibility with traditional musical technology creates conditions for the continuity of musical eras and styles, their interpenetration and synthesis, reinforcing the interest in musical culture in general. In musical practice, the big distribution has acquired a new class of musical instruments that includes keyboards, synthesizers, workstations, multimedia computers, etc. Among the main objectives worked up by contemporary pedagogics in music, the authors focus their attention on the actual possibilities of digital technologies in enriching and enhancing the role of traditions that have been crystallized in practice of musical pedagogics for many centuries. The authors of the article analyze the problems concerning the current significance of contemporary musical notation, and, in particular, the ones being formed by the development of high-tech information environment, as well as the ways to solve some problems of learning music on the basis of computer technologies using the Soft Way to Mozart system.**

Keywords—interactive network systems, keyboard electronic synthesizer, music computer technologies, musical education

I. INTRODUCTION

The sound of music is perceived by a person as a special information space, which is one of the facets of comprehension of the spiritual content of the world, its beauty, which is reflected in the sound. The audialist's perception of musical fabric is connected with living, the immediate experience of the person based on the temporary nature of auditory experiences. It is obvious that the development of musical hearing and musical thinking is faced with a number of problems. Therefore, one of the main tasks of musicology today is to understand the functions of music both as an art and as a written language at a new level, to understand contemporary culture and cultural processes, and the influence of information technology on the formation of a creative personality capable of consciously perceiving various musical phenomena directly, analytically and structurally. Research in the field of musicology, based on a number of interdisciplinary connections (philosophy, aesthetics, psychology, acoustics, neurology, semiotics, etc.), is directed today, on the one hand, to the study of culture, centuries formed in the history of humankind; on the other hand – to the study of the specifics of contemporary perception of music.

II. NEW MUSICAL INSTRUMENTS

In musical practice, a new class of musical instruments that includes keyboards, synthesizers, workstations, multimedia computers, etc. is widely spread. Built on the basis of digital technology, these tools are characterized by considerable expressive resources, which opens up broad prospects for their application in music education [1]. New opportunities allowed us to carry out with the help of such tools not only recording, but also performing tasks. It is not by chance that with the development of the music computer technologies (MCT), this auditory experience has become the foundation for many developments in the didactic direction. The creation of musical compositions with the use of new possibilities of MCT is already widely included in the practice of professional composers. The ways of realization of the concept of musical-computer pedagogical education, allowing us to change the level of training of the teacher-musician at different stages of training, are proved in a number of scientific and pedagogical research.

In the software of professional activities of the contemporary musician and the possibilities of modern electronic musical instruments, the IT, accumulated over the centuries in music and the art of music making, has been fully and completely embodied. The understanding of the fact that a specialized musical computer (MC) is becoming a new multi-functional poly-tumbrel instrument of a musician is being formed. A lot of works are devoted to the musical computer, electronic musical synthesizer and various aspects of their functioning in the contemporary artistic and creative environment.

III. MUSIC COMPUTER TECHNOLOGIES IN EDUCATION

The complex innovative educational system "Music Computer Technologies in Teacher-Musician Training" was developed in the educational and methodical laboratory "Music computer technologies" at the Herzen State

Pedagogical University of Russian, based on the best traditions of the domestic classical music education, as well as innovative foreign experience and modern MCT, developing both actual music and information technology education. This will indispensably affect the problems of music writing and social aspects of the process of computerizing of art education in general [2]. The principles underlying the creation of the methodical system are the basic ones for the formation of a new subject area in musical and pedagogical education, the possibility of which is due not only to the emergence and development of the international art, but also to the preservation of crystallized written traditions of musical culture. Their existence is fundamental to the formed at the present stage professional activities of not only musicians, working with MCT (sound engineers, sound designers, sound producers, performers on synthesizers and MIDI-instruments, etc.), programmers (developers in the field of electronic music systems), but also of music teachers, for whom contemporary technologies offer new possibilities in the solution of didactic problems [4; 6; 9].

The authors see one of the main tasks of pedagogical research in revealing the didactic features of the use of MCT, the possibility of their application in the musical education and education of the younger generation based on classical music, traditional approaches to the methods of broadcasting the products of centuries-old musical culture. It is important that the passion for external, new digital effects and opportunities should not only contribute to the bright and colorful "hot" impressions in communication with the art of music [3], but also develop critical thinking, intellectual and cultural growth of students.

IV. "WHAT IS THE REASON FOR SUBSTITUTING THE GIFTED MUSICIANS BY 'MACHINES'?"

Today, it is clear that the use of the MCT has great potential for writing, performing, researching music and music education and education; that this process should not be feared for, but rather should be supported and actively participated in. So, to the often sounding question: "What is the reason for substituting the gifted musicians by 'machines', and thus lowering the aesthetic value of music art?", composer and musicologist, teacher and scientist Yu.N. Rags, who worked in various fields of music science (problems of music aesthetics, music acoustics, research in the field of music psychology, the interaction of composer and performing arts, the study of the role and place of information technology in music and music education, the role of electronic and computer music in the contemporary musical and artistic space, etc.), replied, "But in this regard, no one sets the task. It is known that the computer and electronic sound fills the now advertising, music videos, television and radio broadcasts, films etc. Their quality is not always satisfying. Therefore, there is a need to prepare in this area real professionals who could really raise the artistic level of art. And schools should not give up the case, and, if possible, to lead them" [4, p. 202]. Calling for the unification of musicians, musicology theories, knowledge about music, Rags says about the need to unite the musicians themselves: "To unite the interests of musicians working in secondary schools and in special music schools in all specialties and at all levels of education (in the children's musical school, comprehensive schools or colleges, Universities)" and "to use the rich opportunities of new IT and in the methodological development of the system of music education" [4, p. 203], to establish mutual understanding between representatives of various areas of musical research.

We would like to emphasize that today information technology is a powerful educational resource. With the help of the Internet you can exchange views, communicate with people from any country, anywhere in the world. But we are not yet using many of the new instrumental capabilities of the digital age in music education. Among them are the benefits of interactive dialogue with a music computer to develop and improve music skills that are applicable in everyday academic practice.

V. INTERACTIVE TEACHING SYSTEM. A SOFT WAY TO MOZART

We present the results of our pedagogical research aimed at studying the possibility of using both auditory and visual features of students' perception of the musical text in the field of general music education by the example of an interactive learning system "Soft Way to Mozart", developed by H. Hiner in 2002 and tested in music schools and studios in 52 countries. Along with such interactive educational programs as "Music in Digital Space", "Music and Informatics", "Murzilka: The Lost Melody", "Clifford: Guess the Melody", "Music Class: Play and Learn", "Ear Master School", "Ear Power", "Sight-Singing Trainer", etc., the program "Soft Way to Mozart' [5] also uses a wide range of media features, putting at the forefront the fundamental principles and scientific achievements of the Russian School of Music.

A feature of the "Soft Way to Mozart" system is the fact that it is actively implemented in the music-text field (individual skills, especially with musical text), allowing us to integrate direct audio experience with the possibility of "detached" analysis of musical notation. This allows us to enrich the art education and education of students, it promotes their spiritual and moral development. It allows us to actively introduce health-saving educational technologies in conjunction with the principles of the highest educational standards. Compared with other schools of the world, such as Suzuki, Yamaha, Kindermusik and some other methodical schools of Bastien, Alfred, Faybers, etc., only the Russian School of Music is based on the developed and tested for centuries academic basis. Most of the above schools and methodological systems are not based on the academic principles of teaching solfeggio, which in the conditions of the Russian School of Music is the cornerstone of the musical and cultural development of beginners (gradual, continuous and systematic development of specific skills, such as writing musical dictations, listening to and reading musical text, transposing, the basics of harmony and applied music theory, etc.).

The central part of the "Soft Way to Mozart" system is specialized software, the necessary condition for the functioning of which is the connection with a digital keyboard musical instrument, carried out by means of a MIDI interface.

The choice of a keyboard instrument such as a clavier, a synthesizer, a MIDI-controller or a piano (in the “Soft Way to Mozart” system, we use digital keyboard instruments) was due to the crystallized traditions of classical music education. It is the keyboard that is able to convey the multi-voice palette of the musical fabric most accurately. Keyboard instruments have been the sound equivalent of a multi-voice sounding space for the last few centuries. Many genres of musical culture are based on the use of scores; they are translated into the format of the clavier for wider use in the study of musical material and teaching IT.

VI. Digital Media Technologies in the Contexts of Contemporary Musical Education

The most important feature of the MCT is the possibility of direct and simultaneous interaction of not only all multimedia structures, but also the algorithm of interaction of these structures with human perception. Digital media technologies have raised the process of visual and auditory perception of the music stream to a new level: the level of a high degree of interaction. The integration of “hot”, direct experience with “cold” analytical have become possible due to the fact that “live” time and experience in “live time” have become a unit managed, not spontaneous, as it was before. In the “Soft Way to Mozart” system, a person can be in the "live time” field and outside it by pressing the synthesizer key. This allowed us to enrich the experience of the auditory perception with the possibilities of visual analysis, as well as rethink the studied material and evaluate it with the help of the built-in statistical analysis.

The possibilities of pedagogy, crystallized in everyday musical pedagogical practice-registration of sound and rhythmic errors, metric and coordination stability, speed of visual, tactile and classroom reaction when communicating with musical text, were initially taken into account in the development of the “Soft Way to Mozart” system. The tested media means inherent in MCT (computer graphics, sound and graphic cards, animation, interactive ways of communication, etc.) have also found their place in this computer-didactic system. The selection of the keyboard as part of a single system of MCT is also due to the visual identity existing between the keyboard and the music space.

VII. An example of practical using the interactive network technologies: advanced training for music teachers

To implement the previously discussed principles of training, a program of advanced training "Interactive Network Technology of Music Training (Program "Soft Way to Mozart")" was developed for the system of additional professional education of teachers of music disciplines at children's musical schools and children's schools of arts and music teachers of secondary schools. One of the main tasks of training in this program is to determine the level of understanding of the role of the IT and multimedia digital tools in teaching skills of playing keyboard instruments, the development of listening and playing from sight.

The thematic plan of the professional development program includes the study of the following topics:

1. The nature of human musical abilities. The role of motivation in music teaching and interactive network technologies of music teaching. MCT. The analysis of the different schools of the world from the point of view of the approach to teaching music. The role of the Russian School of Music in world music education. Interactivity as the foundation of motivation in learning. Features of human cognitive functions. The role of cognitive inquiry in the development of knowledge and skills.

2. The basic principles of the course “Soft Way to Mozart”. Neuropsychological and physiological features of human development in the process of learning music. The role of voice in music teaching. Application of the vocal nature of music in the development of hearing and voice using the “Soft Way to Mozart” system. Development of “musical vision”. Features of visual perception of the musical text and ways to improve the “reading” of music using the “Soft Way to Mozart” system. Statistical analysis of skills development using the measurement system of “Soft Way to Mozart”. Music and linguistics.

3. The main components of the interactive learning system “Soft Way to Mozart”. The components of the “Soft Way to Mozart” system: specialized software, computer and synthesizer interconnection. Features of the “Soft Way to Mozart” system in different conditions and with different groups of students.

Teachers have successfully studied the program, mastered the competencies, including the ability (and willingness) to use interactive network technology of music training in educational activities; to develop training and presentation materials for classes using the MCT and interactive network technology of music training; to conduct classes using contemporary MCT and interactive network technology of music training; to possess the skills of teaching music to people with disabilities through the use of MCT and interactive network technology of music training. In addition these abilities to create the most effective environment for the development of musical and creative abilities of children; ability to apply contemporary methods and technologies of organization and realization of educational process at different educational levels in various educational institutions; ability to develop and implement educational programs to promote scientific knowledge and cultural traditions; ability to create artistic and cultural environment etc. Also they master the ability and willingness to apply rational methods of search, selection, systematization and use of information; orientation in the produced special educational literature on the profile of training and related issues, to analyze various methodological systems and formulate their own principles and methods of training [6]; willingness to apply modern methods and technologies, methods of diagnosing the students’ achievements to ensure the quality of the educational process [7], MCT in music studies at schools for children with deep visual impairments [8].

In the process of training, it was revealed that teachers:

- learnt the multi-aspect and multi-component concepts of "interactive network technology of music training" and "music computer technologies" in the context of modern education; methodological, psychological, pedagogical, organizational and technological aspects of the use of interactive network technologies of music and MCT training in the modern educational process; the possibility of using interactive network technologies of music and MCT training in the field of artistic and aesthetic education of children;
- were able to identify the problems associated with the achievement of new quality of education and propose their solutions based on contemporary interactive web technology music learning and MCT; to analyze and critically evaluate the features of development of educational systems in terms of operating high-tech information educational environment; to develop models of educational activities based on modern interactive web technology music learning and MCT;
- owned individual and group technologies of work with the use of interactive network technologies of music and MCT training in the modern educational process; methods of using the possibilities of interactive network technologies of music and MCT training to ensure the quality of educational process management; technologies of interactive music training in the network space, forms of organization of virtual classes, training courses, competitions, academic concerts online; methods of presenting the results of the activities based on contemporary interactive network technology of music and MCT training.

In 2013-2018, based on educational and methodical laboratory Music Computer Technologies of the Herzen State Pedagogical University of Russia, refresher courses were conducted for teachers of musical schools and boarding schools, and implemented the elements of the distance support program of excellence "Interactive Network Technologies Music Learning (the Program "Soft Way to Mozart"). Also in the educational and methodical laboratory Music Computer Technologies, music training was organized on the basis of the educational system "Soft Way to Mozart" for students of various (non-musical) faculties of the Herzen State Pedagogical University of Russia in the framework of the pedagogical experiment in the preparation of the master's thesis on the topic "Information educational environment as a factor in the formation of general cultural competencies of students by means of the MCT" (master's program "Information Technology in Education", implemented at the Faculty of Information Technology of the Herzen State Pedagogical University of Russia). Specialized software was installed with the support of the Resource Center of Informatization of the Herzen State Pedagogical University of Russia. In work with the students and the teachers visual, visual-animation and other interactive modifications were used developed for the "Soft Way to Mozart" system.

VIII. THE RESULTS OF USING THE "SOFT WAY TO MOZART" SYSTEM

The use of MCT and the program "Soft Way to Mozart" contributed to the wide development of interest in the conscious reading and performance of piano music in 100% of the students of the Herzen State Pedagogical University of Russia, who took part in the piloting of the system. All the participants learned to play the piano with both hands by note and by heart musical works in the group classes from 5 to 10 people (with one teacher). The majority of students (91%) successfully performed learned works on the acoustic piano, demonstrating a high level of self-esteem and self-confidence. The majority of the participants coped with learning the plays for initial classes of musical schools and started the analysis of more complex works (98%). The choice of the visual presentation of the notation was based on personal preference, associated with the preliminary experience of every student and varied: some of them chose the original notation (54%), others – a simplified letter (46%).

The classes with groups of teachers at children's musical school showed that the program "Soft Way to Mozart" is perceived by professional teachers as a multimedia system, potentially able to enrich the palette of classes in addition to the school program. Familiarity with the basic principles of the "Soft Way to Mozart" system caused understanding of the system as a traditional but modified approach to teaching key skills of playing an instrument, reading notes from a sheet, memorizing musical works at a more technological, interactive level.

The results of the pedagogical research were also presented at:

- 12th – 16th annual International Research and Practical Conference "Contemporary Musical Education" (from 2013 till 2017) held together by the Herzen State Pedagogical University of Russia and St. Petersburg State Conservatory named after N.A. Rimsky-Korsakov;
- International Workshops "Music Computer technologies in the Digital Age School", organized on the basis of educational and methodical laboratory Music computer technologies, the Herzen Sate Pedagogical University of Russia (from 2014 till 2018);
- Annual International Research and Practical Conference "The Child in the Contemporary World", Saint Petersburg (2014, 2017, 2018).

The participants of the seminar "Music Computer Technologies in the Digital Age School", teachers of music academies and teachers of music schools from Russia, Poland, Belarus, Kazakhstan, Israel, Spain, Costa Rica, the USA, Turkey, France noted that the MCT and the "Soft Way to Mozart" system works in different countries of the world and on different continents equally effectively. Children are passionate about the analysis of the musical works; they compete in who and how many will read the plays with the least number of mistakes. It turns out that it is not necessary to have a fake artificial fantasy world (one remembers the boom that was caused at the time of computer toys like 'Guitar Hero' and 'Garage band' around the world, when children

spent hours improving the skills of playing on artificial, specially made only for such a game, instrument). Musical art is an inexhaustible source of real treasures that really enrich every child. The love for music and the desire to be able to play musical instruments have not only survived, but also increased thanks to the lessons.

The teachers also noted that the musicians should teach children to play Mozart and Bach on the "real" keyboard and with the help of "real" musical text. If reading of the musical text, and musical instruments becomes popular and widespread, from the broad masses of fans quite a large contingent of gifted children will crystalize, and specialists in music and public schools will have more time to educate talented students with advanced musical thinking, capable of creative self-development, attending the Philharmonic concert halls and theatres.

By the example of the "Soft Way to Mozart" system, it was possible to trace how the MCT are able to integrate the established pre-digital psychological modalities with new multimedia capabilities. New multimedia modules in a live time mode are easily integrated with the procedural nature of the musical language and they allow us to present the musical notation in a new, dynamic quality. The direct perception of the musical flow is combined with analytical, which greatly enhances the didactic possibilities and translates the cognitive experience of students to a new level of development. The synthesis of MCT and modified musical notation opens up new didactic possibilities in the use of musical notation, the actualization of its use in the digital age. Digital enrichment of musical notation using the "Soft Way to Mozart" system can help to solve a number of problems of music education in the 21th century and promote a new stage of music development as one of the most important facets of the world comprehension.

IX. CONCLUSION

The diversity, the global applicability of the MCT, provide new, in fact, limitless possibilities of self-realization, stimulate the rapid development of intelligence, raising training to a new level. Compatibility with traditional musical technology creates conditions for the continuity of musical eras and styles, their interpenetration and synthesis, reinforcing the interest in musical culture in general.

The results of using the system in a relatively short period of time showed that the media use of MCT in the field of audio and visual material in conjunction with the possibility of direct interaction with the musical text on the tactile level is the way to integrate "hot" – direct and "cold" – analytical experience of the man.

Music develops human brain, and nothing contributes to the development of creative abilities, as the desire to sing, perform music and direct the ability to play a musical instrument. The authors believe that now, when the world is experiencing another economic and political crisis, musical culture, musical education, based on high spirituality, tolerance, intercultural communication, can affect the level of public consciousness, support and develop contacts between experts in various fields of knowledge and the classical music art [9].

The possibilities of the musical computer (MC), due to the functioning of high-tech information educational environment, favor, as never before, the unification of people from different countries and continents, enrichment and strengthening of the processes of preservation and development of centuries-old traditions of musical culture in teaching practice.

References

[1] I.B. Gorbunova, "Electronic musical instruments: to the problem of formation of performance mastery". Int'l Conference Proceedings, Budapest, pp. 23-28, 2018.

[2] I.B. Gorbunova, "Musical-computer technology: the laboratory. Mediamusic". Retrieved from: http://mediamusic-journal.com/Issues/1_5.html

[3] M. McLuhan, Retrieved from: https://ru.wikipedia.org/wiki/ McLuhan, Marshall

[4] Yu.N. Rags, "Prospects of development of Informatics course in music educational institutions", Contemporary Musical Education – 2003, Proceedings of the II International Scientific and Practical Conference, ed. Irina B. Gorbunova, Saint Petersburg: Publishing House of the Herzen State Pedagogical University of Russia, pp. 200-203, 2003.

[5] Soft Way to Mozart. Retrieved from http:// www.softmozart.com / www.softmozart.ru

[6] A.E. Krause, A.C. North, , L.Y. Hewitt, "Music-listening in Everyday Life", Devices and Choice, Psychology of Music, vol. 43, Issue 2, pp. 155-170, 2015.

[7] A. Middleton, "Reconsidering the Role of Recorded Audio as a Rich, Flexible and Engaging Learning Space", Research in Learning Technology, vol. 24, 28035, 2016.

[8] I. Gorbunova, A. Govorova, "Music Computer Technologies in Informatics and Music Studies at Schools for Children with Deep Visual Impairments: From the Experience". In: Pozdniakov S., Dagienė V. (eds) Informatics in Schools. Fundamentals of Computer Science and Software Engineering. Lecture Notes in Computer Science, vol. 11169. Springer, Cham, 2018.

[9] G.G. Belov, I.B. Gorbunova, "Music and Cybernetics, Music and Time", No. 11, pp. 25-32, 2016.