Musical Informatics Course for Musicians with using Music Computer Technologies

Irina B. Gorbunova, Andreas Kameris, Elena N. Bazhukova

Abstract: *All over the world, educational researchers are looking for new ways to optimize music education in accordance with the new capabilities of digital tools. World-wide changes are being implemented through transmitting and presenting the information. Digital technologies have permeated music and musical education. Advances in sound recording and music creation technology, combined with new media capabilities, have defined previously non-existent directions for the development and distribution of music and require knowledge that musicians who have received classical musical education do not possess. The subject of the article is the evolution of current theoretical and practical bases for improving the knowledge of musicians using music computer technologies.*

Learning to play electronic musical instruments is to be required by contemporary society in connection with the demands for a higher level of professional activities in the field of music, the need to conduct a high-quality teaching that includes computer technologies in the field of art as s particular of the Digital Age School. The discipline of Musical Informatics, which has been constantly developing since the mid-70s (IRCAM, France), can have a significant impact on the formation of subject knowledge of musicians associated with the development of new music computer technologies and their use in creativity and training.

Keywords: *electronic musical instruments, musical computer, musical education, music computer technologies, musical informatics.*

I. INTRODUCTION

Information technology in musical education

The evolution process associated with the development of musical instruments as synthesizers of musical sound (from the first acoustic instruments to modern electronic and digital ones) allows us to trace the influence of technologies (including information ones) on the musical- creative and musical-educational processes.

Detailed examination of the particularities of the architectonics of musical sound provide an opportunity to explain the structure, the diversity and the various interpretations of the concept of "musical sound," as well as the connection with the contemporary technical possibilities of notation, preservation and elaboration of musical sounds.

The main stages of evolution of the concept of "musical sound," which reflects the changes of sound material itself during the course of development of musical practice allows us to identify the main features of digital musical instruments, their place in the system of contemporary musical education, explain the need for a contemporary musician to study the discipline "Musical Informatics", and also make it possible to make a meaningful content of this new subject area.

The emergence of new musical instruments or musical synthesizers, according to the authorial conception, is stipulated by two main reasons. The first of them is musicians' aspirations of enriching the palette of their musical artistry. The second reason is connected with the historical perfections of the musical instrumentarium, which in its construction aspires to rely on contemporary achievements of science and technique in the domain of creation of sound.

The level of development of contemporary program and machinery means of music computer technologies (MCT) makes it possible to model diverse stages of development of systems of musical sounds.activities.

II. METHODOLOGY

Musical informatics, in conjunction with other disciplines, helps integrate the contemporary musician in his or her professional activities. The purpose of the course of musical informatics is creating pre-conditions for expanding the professional capabilities of the musician with the use of modern digital technologies and facilitate the fuller use of the creative potential of the performer, composer or teacher of music.

The purpose of the subject is mastering MCT, the software and hardware used in the professional activities of the musician and acquiring, by him or her, experience for working with digitized and synthesized sound and musical material in various formats as well as many other similar things.

The need to find new methods and approaches to teaching musicians computer science is also due to the fact that a contemporary musical synthesizer is a digital instrument with appropriate software, in fact, a specialized computer for working with music information – musical computer.

The interdependence of hardware and software in the electronic musical synthesizer characterizes the sound hardware-software complex of the instrument.

With this in mind, there is a need to develop new abilities of the musician to work quickly and efficiently with musical information on the basis of new tools,

analyzing and processing the results, justifying the decisions made in creative activity, based on the available musical information. This should be taken into account while training specialists, since from the earliest education students of music schools have a practical need for knowledge about information processes and basic concepts of informatics as elements of real creative activity on the synthesizer.

The need for such an approach is clearly dictated by the current state of training students and teachers of music schools. As the results of our ascertaining pedagogical experiment have shown, the use of knowledge in computer science (informatics and musical informatics) by musicians and the ability to apply them in creative activities, as a rule, are fragmentary, the musicians have little knowledge of the necessary level to fully master the modern musical synthesizer as a sound hardware and software complex.

III. LITERATURE REVIEW

We analyzed the methodological problems of teaching Computer Science and Information Technology (IT) to students of musical and pedagogical specialties in Russian Universities (Belov, Gorbunova, Zalivadny, Kibitkina, Lozhanova, Konovalov, Mezentseva, Petrova, Plotnikov, Chibirev [2]-[11]) and abroad (I. Alieva, S. Wise, R Crawford, J. Southcott, R. Chao-Fernandez, S. Roman-Garcia, A. Chao-Fernandez, V. López, Goh Khee Meng, I.Trush, S. Sosnevas, Lic. Camila Cortina Bello, H. Hiner, K. Hastings, A. Kameris, T. Permezel, N. Zhilyaeva, O. Nelia Hernández Bean, Lourdes García Esperón, Córdova Pacheco Gustavo Erasmo, L. Yanpolsky [12]-[28]).

Researchers and educators note that, despite the effectiveness and accessibility of digital technologies in the educational process (Horita [29]), MCT and music technologies - in music education (King, Himonides, Ruthmann [30], teachers remain conservative in their approaches to teaching music disciplines, music composition (Wise, [32]); in the real music and educational process, music training programs do not correlate in any way with the teaching of information technology (it) (Crawford & Southcott [16]); despite the fact that it quickly enters all professions, this process is much slower in the music field (Chao-Fernandez, Roman-Garcia, Chao-Fernandez [13]). It is revealed that the effectiveness of training is achieved when new knowledge is obtained in the process of creative activity [9]; [14]; [15], when the educational activity is as close as possible to the professional activity of a musician, and new disciplines are studied in the context of the musician's activity [6]; [9]; [10]. Taking this into account, it is advisable to build the process of teaching computer science and its applied aspects for students – future music teachers - on the basis of a contextual approach [10]; [12]; [13]. This approach allows to approximate the content of education to the creative professional activity of a musician, creates the conditions for

better understanding and effective learning of the program material on Informatics, promotes the formation of skills to independently use the acquired knowledge in music and creativity and teaching.

Thus, a necessary requirement for professional training of future specialists-musicians and especially musicians-teachers is the development of information competence, which involves not only mastering the means of modern information technologies and ICTs, but also their application in solving various problems in the field of musical creativity, including inclusive musical education [34]; [35].

Today, it is quite obvious that a serious scientific generalization of what has been done in this area of development of musical informatics as a field of scientific knowledge and as a new academic discipline that is taught in many universities around the world is required, but the content of the training course "Musical Informatics" is still too unstable, too different, depending on the knowledge and level of understanding of a particular teacher.

IV. RESULTS AND DISCUSSION

As the results of our pedagogical experiment have shown, the use of knowledge in computer science (informatics and musical informatics) by musicians and the ability to apply them in creative activities, as a rule, are fragmentary, the musicians have little knowledge of the necessary level to fully master the modern musical synthesizer as a sound hardware and software complex.

These results show that there are problems in this area:

- the unaccounted fact of need for intellectual and technological improvement of musical and educational process;

- the lack of special attention to the psychological features of perception of information by students-musicians (creative thinking, artistic perception, emotional memory, attraction to certain types of artistic activity), which affects the difficulties in teaching computer science and low educational motivation of students of music schools;

- the lack of attention to the age peculiarities of training students of music schools, where children get a basic understanding of music on a synthesizer;

- the lack of educational and methodical manuals on Informatics for students and teachers-musicians.

The scientific search for a solution to the problem of teaching computer science to music school students aims to resolve the following contradictions:

- the discrepancy between the level of training of students and teachers of the music school in the field of computer science training and modern requirements for professional musicians;

- the need for knowledge of computer science, without which the musician be-comes impossible to understand the information processes on the electronic synthesizer and the lack of methods of teaching computer science to music school students.

General idea of the Musical Informatics training course

A. New discipline "Musical Informatics"

The problem situation is eliminated by developing a methodology for teaching musical Informatics to music school students using the sound hardware-software complex EMI (musical synthesizer).

Creation of methods of teaching Informatics to music school students and introduction of a new discipline "Musical Informatics" at the electronic departments of children's music schools and art schools, where audio software and hardware complex becomes a new means of teaching Informatics to musicians and at the same time acts itself as an object of practical orientation in teaching.

The method developed by us and the educational process being conducted for 10 years allow us to consider an electronic musical synthesizer as an instrument to study Informatics with:

- as an audio hardware-software complex of training in Informatics students of music schools;

- as a means and object of learning Informatics, creating a learning environment that contributes to the formation and development of information competencies of the musician.

B. Objectives of the training course "Musical Informatics"

The following tasks were solved:

1) we studied the problems and prospects of training in Informatics students of music schools;

2) a method of teaching computer science using sound hardware and software complex-modern electronic musical instruments and MCT were developed;

3) the principles of selecting the content of training in Informatics students of music schools were applied;

4) the features of the use of EMI as a learning tool and object of study of Informatics by students of music schools were revealed;

5) there was developed an educational and methodical complex (a program / a training course, a textbook, a creative notebook, an electronic textbook for distance support of education, audio and video materials) for students of music schools;

6) the effectiveness of the use of EMI and MCT teaching computer science to mu-sic school students was experimentally tested.

C. Essential topics of the *Musical Informatics* course

The following are some of the topics of the training course "Musical Informatics", which is based on the correlation of requirements for knowledge of students of secondary schools from the course "Informatics" and students of music schools, mastering software and hardware EMI.

The discipline of Musical Informatics includes the following sections:

The Subject of *Musical Informatics*

Music, Mathematics, Informatics: The Bounds of Their Interaction

Analysis as concerns harmony in works of music art and mathematical methods of their description.

Tentamen novae theoriae musicae ex certissimis harmoniae principiis delucide expositae (on the theory of music by L. Euler).

The descriptive-symbolic conception of music («Grammatica Speculativa» by Ch. S. Peirce and others).

On the characterization of various aspects of music creativity or "Musical Mathematics".

Musiques formelles by I. Xenakis.

Music programming.

Audio-visual synthesis.

Architectonics of Acoustic and Digital Musical Sound

Sound vibrations.

Musical sounds (fundamental tone, harmonics, notes).

The spectrum of sound.

The intensity and volume of sound.

Stereophonic parameters.

The modulation of high frequency vibrations.

The theory and practice of preserving sound.

Digital recording, the processing of sound and playback.

Musical Synthesizers

Extracts from the history of musical synthesizers.

Electronic musical instruments.

The musical instrument as synthesizer of musical sound.

Technologies of Sound Synthesis

The basic types of sound synthesis.

Sound filters: low-pass, hi-pass, band-pass, notch.

Equalizer.

Sound cards.

Audio mixing console.

Musical Computer

Musical computer: excerpts from history.

Computer modeling of music creative elements.

MIDI.

Musical computer hardware.

Musical computer software.

Musical computer setting.

Musical computer as the new multifunctional multi-timber musical instrument.

Musical computer as the tool of teaching in the context of the basic methodological principles of the primary, secondary and higher additional professional and inclusive musical education.

Musical computer as an instrument of the performer.

Digital Audio Workstation

The creation of a project, settings, the basics of working with an audio fragment.

The dynamic sound processing.

The frequency sound processing.

The spatial sound processing.

Reverberation.

Modulation effects.

Mixing and mastering of the musical project.

Digital Musical Synthesizer as a Modern Software-Hardware Complex for Teaching Musical Informatics

The modern digital musical synthesizer as part of the subject of music informatics.

Digital musical synthesizer: instrument controls.

Digital musical synthesizer as a means of performing music.

Professional Music Software

Audio editors.

Note editors.

Program music designers.

Automated musical arrangers.

Sequencers.

Teaching musical software.

On-line Music Teacher Assistance Services

A review of sheet music on-line software.

On-line audio editors.

Programs for microphone sound recording on-line.

Music studios.

Appendices

Appendix 1. A table of General MIDI instruments (GM)

Appendix 2. *Mathematical methods of research in musicology* course by M.S. Zalivadny

Appendix 3. Armenian universal analytical chart *AK-4* by V. Goshkovsky

Appendix 4. Examples of the use of matrix recording in analyses of music structures

Appendix 5. The examples of developing the original software by students participating in the *Musical Informatics*

V. CONCLUSION

It should be noted that the studying of the discipline "Musical informatics" is still problematic. First of all, this is due to the lack of a unified concept of information technology education of a musician with the use of specialized professional software and hardware at various levels of training. Also, a significant role in this process is played by the lack of integration of disciplines of the music-theoretical cycle in the system of training a contemporary musician and the possibilities of a high-tech digital educational environment; the lack of experience in using digital educational resources and MCTs in the real educational process. The lack of a scholarly and psychological basis for research of the existing experience of teaching musical informatics based on the capabilities of modern MCTs engenders the stimuli for feather research in these directions.

In this connection, the practical experience of forming and improving the discipline of "Musical Informatics" in the Education and Methods Laboratory *Music Computer Technologies* at the Herzen State Pedagogical University of Russia is extremely valuable. The main content aspects of teaching the course "Music Informatics" are presented in this article. We hope that our experience will be useful for teachers who are developing new educational programs that are related to the teaching of music Informatics. We also look forward to further discussion and development of the experimental concept we have developed.

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