Music Computer Technologies: Mobile Technology in Contemporary Musical Education

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***Abstract*:** *The processes of informatization transform the environment of professional activity of the modern musician, form new educational needs of students of various musical specialties, cause changes in the activity of the teacher-musician. This is due, in particular, to the use of digital educational resources, the widespread introduction of techniques and methods of network interaction and modern music computer technologies (MCT), which have a wide range of capabilities. These possibilities are truly limitless, they allow you to discover new artistic worlds. One of the actual problems of musicology is the study of the processes associated with the spread of information culture and their influence on the formation of the contemporary musician, in particular, the formation of musical ear. The authors of the article analyze the possibilities of mobile technologies in the field of development of musical hearing of children's musical schools and children's schools of arts. Based on the results of many-year practice of teaching solfeggio with the use of mobile technologies and the conducted pedagogical experiment, the authors conclude about the high educational potential of cloud-oriented technologies in the system of modern music education. Mobile technologies can significantly expand the forms and methods of teaching solfeggio. The authors of the article note the need for further scientific and pedagogical research in this area related to teaching with the use of modern mobile technologies, the development of training programs and professional retraining of teachers of musical and theoretical disciplines.*

Keywords: *mobile technology, musical hearing, music computer technologies (MCT), solfeggio, musical education*

1. Introduction

The processes of informatization transform the environment of professional activity of the modern musician, form new educational needs of students of various musical specialties, cause changes in the activity of the teacher-musician. This is due, in particular, to the use of digital educational resources, the widespread introduction of techniques and methods of network interaction and contemporary music computer technologies (MCT), which have a wide range of capabilities [1-3]. The development of a new educational direction – music computer technologies as a learning and creative environment in general, professional and special (inclusive) musical education - began in the Herzen State Pedagogical University of Russia in 2002, when Educational and Methodical Laboratory ‘Music Computer Technologies’ (www.muslab.spb.ru) was created under the guidance of one of the authors of the article. The laboratory organizes academic conferences and seminars, creative competitions and concerts. Developed, licensed and implemented in the pedagogical process of professional and educational profile of Bachelors of art education ("Music Computer Technologies"), the program of Master's training ("Music Computer Technology in Education"), a number of specialties for teachers and musicians are trained at refresher courses.

These possibilities are truly limitless, they allow you to find new artistic worlds [4-7]. One of the actual problems of musicology is the study of the processes associated with the spread of information culture and their influence on the formation of the contemporary musician [8-10].

As part of the dynamically developing information technology, mobile technologies combine tools and methods that allow working with digital data through the use of mobile devices connected to information networks (laptops, smartphones, tablets). For those who are accustomed to the standard computer keyboard, it is

possible to connect it to the tablet via USB output, Bluetooth or Wi-Fi Direct system. MIDI keyboard is connected in the same way. Tablets can be connected to other devices: external drives, monitors, printers, scanners, etc.

An important advantage of mobile technology is the ability to provide rapid access to cloud-based educational services and resources. The main purpose of cloud computing and cloud services, as well as a number of Web applications, is to provide the user with access to all their data or software from any digital medium. Owners of tablets on Android and iOS (Apple) are familiar with the concept of cloud storage, as Google-Disk and iCloud services allow you to store all sorts of information (photos, contacts, video, audio, applications), as well as synchronize your data from tablets and smartphones with the cloud.

2. Mobile Technology In Education

Mobile technology will change the quality of interaction between teachers and students, providing access to shared resources and exchange of information at any time. This will contribute to the testing and implementation of innovative teaching methods, improve the organization and automation of processes, as well as open up fundamentally new economic opportunities. In the field of musical hearing developing mobile technologies can significantly expand the forms and methods of teaching solfeggio [8], so it is important to identify their educational potential.

Currently, there is a growing and widespread enthusiasm for tablets, which offers an infinite number of easily accessible and exciting Internet services and applications. For today's students tablets are not something unusual and complex, because due to the high degree of their interface intuitiveness they can be used without learning the principles of operation of these devices. Tablet technologies can be used as a completely new, different in form and content platform for more entertaining and interactive learning [11-15]. In this regard, an important task is the development of teachers-musicians practical teaching skills with the involvement of mobile technologies. The introduction of a new innovative form of learning will require special research and adaptation of learning materials to mobile devices. The need to adapt the material due to the fact that the content on the mobile platform is served in short blocks, should be extremely straightforward and simple, but without prejudice to the content and taking into account the peculiarities of music classes.

Unfortunately, not every teacher today owns the means of high-tech educational environment. All this poses fundamentally new challenges to the education system that require new technological solutions and the development of pedagogical conditions for their effective use, the search for scientific approaches to the organization of musical education process.

To solve these problems, first of all, it is necessary to get acquainted with the quality and features of the widespread and popular mobile applications that are used for the development of musical hearing.

3. Mobile technology in teaching theoretical disciplines

At the moment, there is a large number of training applications aimed at the development of various aspects of musical literacy, musical hearing and thinking. Most of the well-known mobile applications are designed to acquaint with musical notation and the basic elements of the musical language, to promote the development of harmony, harmony hearing and sense of rhythm, to control the accuracy of pitch intonation, to expand the auditory baggage, in short, to be a simulator for the development of musical and auditory skills.

Many students use a variety of applications to work with audio (trim ringtone, connect melodies to each other, etc.) or video (video conversion, processing, the ability to make a video clip from photos, picking up music to it; for example: Photo Editor Pro, Song Editor, Magisto), as well as simple applications (for example: Drum Pads 24 or) for composing music in different modern styles (Drum'n'bass, Dubstep, Electronic, Trip Hip Hop, etc.). These applications contain professional Studio samples, pads (synthesized sounds) that allow you to create and record your own improvisations, as well as share them with friends.

An important stage in the formation of musical abilities at the initial stage of training is the development of singing skills and elementary intonation. Here can help sounding lullabies, nursery rhymes, proverbs, tongue twisters, etc., which enrich the vocabulary, develop articulation apparatus, phonemic hearing, etc. You can give an example of the application of amusing rhymes and patter rhymes on cardboard, which in an interactive form will help pupils cope with articulation problems.

The application Absolute hearing-2 has a large number of exercises focused on the development of hearing: compare the hearing intervals, determine the frets and chords, record melodic dictations, develop a sense of metro-rhythm, the presence of a microphone on the tablet allows you to record the sung intervals and chords. The undoubted advantage is that the training of hearing and the form of knowledge testing turns into an exciting process, and it is very welcome by students. The ability to create your own exercises allows teachers to customize each student's learning at an individual pace and level of difficulty. The presence of a theoretical section in the application (articles "Intervals", "Chords", "Harmony", etc. written by the authors [16-18]) provides pupils with the information necessary to perform interactive exercises.

Music First has created an interesting app for music teachers and students based on cloud solutions. The site contains a variety of music tutorials that were previously only available on DVD (sequencers; learning to play various instruments; programs for training hearing; music editors; as well as programs that introduce the basics of music theory and history, etc.). All actions of students and teachers are stored and synchronized in the cloud, allowing teachers to conduct a thorough monitoring and evaluation of the learning process at any time. This is an extremely useful resource for distance music education.

A variety of exercises that develop singing skills and expand the vocal range are contained in the Vocalist Lite application. You can import the necessary melodies into the application, sing, and the screen instantly displays comments if the wrong note is sung. This application is convenient to use for self- test, for example, before passing the learned numbers on solfeggio.

For the development of creative abilities in the classroom solfeggio convenient to use the application Chordbot Lite, with which students can make their own arrangement to the previously recorded dictation or harmonization to the learned melody. This form of work is particularly suitable for performers on wind and stringed instruments who have difficulty playing the piano when performing creative tasks on solfeggio.

Owners of iPad, iPhone, iPod in standard applications have GarageBand program, which is a digital audio workstation and sequencer for recording and playback of multi-channel audio. This app has over a hundred virtual instruments. You can play these instruments using the virtual keyboard, but you can also connect a MIDI-keyboard. An important feature of this application is the section Music Lessons, which allows you to download audio and video lessons of playing the piano or the guitar, and comments and tips make it possible to quickly improve the skills of the game. At the same time, pupils independently use a variety of educational applications, which helps them prepare for various subjects of the musical-theoretical cycle.

Applications Walk Band for Android, GarageBand for iOS allow you to create a whole orchestra of different instruments, which is a great alternative to noise orchestras. This form of work is suitable for learning new rhythmic patterns. Rhythm is a leading component of the formation and organization of musical tissue in general, so a variety of exercises will only improve the mastery of the elements of the metro-rhythm. Ensemble playing is a comprehensive method of pupils' development it provides an opportunity for mutual learning and mutual education, as a fertile ground for the birth of a new musical sound in an atmosphere of cooperation. A well-chosen repertoire of ensemble music expands the horizons of what children know in music, replenishes the Fund of their auditory impressions, which plays an active role in the process of formation and development of musical thinking and intelligence.

The NotateMe Now app, with its recognition feature, allows you to quickly record sheet music in the usual handwriting way with a stylus (e-pen) or with a touch of a finger: the tablet simulates a sheet of paper, and the e-pen acts as a pen or pencil.

In some applications, the multichannel recording feature opens up a huge field of musical creativity and various forms of work with musical fragments for students. You can write small scores, change their instrumentation, to cut and combine different pieces, write down the pupils' own works, and improvise. The material is recorded in MIDI format, created or imported MIDI-files can be edited in the piano roll or using the stave. Application functionality, such as MidiSheetMusic, allows you to import the finished MIDI material into PDF format (for printing). Also, the work can be listened to, on the screen at the same time marked sounding notes on the stave and virtual piano keyboard.

4. A professional development program "Tablet and cloud-oriented technologies in contemporary musical education" for teachers of children's musical schools and children's schools of arts: some methodical aspects

We have evolved a professional development program for teachers of musical and secondary schools "Tablet and cloud-oriented technologies in contemporary musical education". Fragments of classes using these technologies in the teaching of various music disciplines in the school can be seen here: https://youtu.be/rL-G5Pi80rs.

It is important to note that the use of mobile applications in the classroom for ear training in children's musical schools and children's schools of arts can be combined with traditional forms of learning. For example, when studying the theme "Reduced triads" at the piano Department in the fifth grade (the full program of training in the system of primary professional music education in the children's musical schools and children's schools of arts in Russia is nine years) you can use the following options of tasks:

1) Compose a 4, 6 or 8-beat melody in harmonic minor using the Maestro app. This application is a simplified version of the musical set of one-voice melody with a choice of key, instrument, etc.

2) Import the composed melody into MIDI format and open it through the WalkBand application (for recording the second voice or harmonization and subsequent instrumentation, adding a rhythmic accompaniment) or through the Chordbot Lite application (for automatic arrangement of the selected harmony also with the use of diminished triad).

3) Record the performance of the composed melody with accompaniment using multi-channel recording in the WalkBand and export to MP3-format.

4) Listen to several examples (e. g. the part of Naina from Glinka's opera Ruslan and Lyudmila, the minuet of J. B. Weckerlin, the Aria of the Snow Maiden from the opera The Snow Maiden by Rimsky-Korsakov, etc.) on the YouTube channel or in the Perfect Piano application (on the scores in PDF format while listening a pupil sees the piano keyboard, on which the sounding keys are marked in real time). To determine which passage sounds the diminished triad or tritone, to make them the screenshots and in the resulting drawings to mark these chords and intervals. The answer should be sent to the General class forum or to the cloud storage of homework or work in the classroom.

Having studied the available software and features of their perception by students, having practical experience in this area, we came to a number of conclusions. First of all, we note that the process of mobile learning includes the main pedagogical functions (motivational, information, function of management of educational activities, forming skills, controlling and correcting) and the possibility of information and telecommunication technologies to stimulate creative activity to the study of the material and the search for an answer, flexibility, adaptability and taking into account students' cognitive capabilities, training, the ability to take different ways of answering.

There are a number of undeniable advantages of using mobile technologies in education and, in particular, in the development of musical hearing and thinking. Note the most, in our opinion, significant.

At the initial stage of learning tablet computer is usually used as a replacement of e-books and textbooks. However, the possibilities of the electronic textbook in this case are greatly expanded: wireless Internet access

using Wi-Fi technology opens the way to a huge knowledge base, for students becomes available to help the tutor and the teacher (commenting, discussion, video, etc.). Thanks to access to the Internet, you can instantly search for the necessary information, update it, create a hyperlink, view materials online, listen to audio, view video — that is, make the electronic textbook more interactive and multimedia. The teacher has the ability to create access for students to a huge music library. You can also create interactive servers with music quizzes and tests, which will be available to all students through the web-browser of the tablet.

5. Access to learning tools, visibility and adequate forms of implementation of educational interaction

The basis of any pedagogical process is access to learning tools, visibility and adequate forms of implementation of educational interaction. Thanks to the tablets, this is very easy to achieve. Programs come to life with a single touch to the screen, learning takes place in a completely new dimension (as you know, visual-spatial methods of perception of musical material are best suited to achieve concentration). Handwriting connects motor memory to the learning process at a higher level than using a PC keyboard.

Compact tablet allows you to use it in any conditions. The presence of a touch keyboard and a gesture interface, a silent set of book and music text allow users to focus in a crowded environment. In the process of private learning, you can use headphones, which allows students with different levels of knowledge to be in the same class, performing individually selected tasks.

A sufficiently powerful acoustic subsystem (or an additional portable speaker system like JBL Go) allows you to use the tablet as a music center or a recording device: repeatedly listen to a certain piece of the sounding work, adjust the volume, change the ratio of high and low frequencies, etc. in the lessons of solfeggio, you can sound the score, turn off certain instrumental parts, change the timbres, etc.

Conclusion

Mobile learning applications and simulators, based on the integration of various forms of activity [19-27], significantly enhance the development of musical hearing and thinking, since the understanding of the elements of the musical language occurs through sensations and visual representations, which in comparison with verbal communication has a more specific, simple and dynamic nature of perception [28-35]. Indisputable effectiveness on the solfeggio lessons has interactive creative exercises with the use of mobile technologies. Interactive exercises activate auditory attention, train musical memory and various aspects of musical hearing, develop taste and observation, imaginative and emotional thinking, including the use of music computer technologies for children with deep visual impairments [36-38].

The use of mobile devices creates the need to organize the educational process with an optimal balance between the established traditions and new information technologies in the teaching of music. At the same time, the process of mastering knowledge is translated into the plane of finding the necessary information, repetition and cramming turn into an exciting creative process, and the study of solfeggio becomes one of the ways of contemporary musical communication.

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She was on a number of business trips abroad, among them working trip to the USA (1999); lecturing and giving research and practice seminars in Hungury (2003, 2005, 2017); business trip to the UK (2016); she was a member of the Jury of national and international competitions of musical creativity, including Bridge of Friendship (Dortmund, Germany, 2011), etc. Work experience; 1990 – 2010 - Associate Professor, Professor of the Department of Information Technology of the Herzen State Pedagogical University of Russia, St. Petersburg; 2010 - present - Full Professor of the Department of Information Technology, Institute of Computer Science and Technological Education of the Herzen State Pedagogical University of Russia, St. Petersburg; 2002 – present - Chief Researcher of the Educational and Methodological Laboratory Music Computer Technologies of the Herzen State Pedagogical University of Russia, St. Petersburg. She has more than 300 scientific publications, among them are monographs Music Computer Technologies: Historical-Theoretical and Practical Aspects, St. Petersburg: Publ. house "SMIO Press" (2007, 560 pp.) and Music Computer Technologies: The Problem of Modeling the Process of Musical Creativity, compiled with participation of S. V. Chibirev , St. Petersburg: Publ. house of the Herzen State Pedagogical University of Russia (2012, 160 pp.); course book Information Technology in Music, vol. 1 – 4: vol. 1, Architectonics of musical sound (2009, 175 pp.), vol. 2, Musical Synthesizers (2010, 205 pp.), vol. 3, Music Computer (2011, 411 pp.), Music, Mathematics and Computer Science, vol. 4, compiled with participation of Mikhail S. Zalivadny (2013, 181 pp.), St. Petersburg: Publ. house of the Herzen State Pedagogical University of Russia. Her research activities include such directions as: MCT in professional music education (as a means to expand creative opportunities); MCT in general musical education (as one of the means of education); MCT as a means of rehabilitation of people with disabilities; MCT as the new direction in preparation of specialists of humanitarian and technological profile; MCT in the field of digital arts; MCT in information technology, psychoacoustics and musical acoustics; system of training arrangements and the art of performing skills on electronic musical instruments. Her circle of interests also includes the problems of interrelation of natural and technical sciences and humanities, as well as the possibilities of applying the results of such interrelation for the purposes of music education and upbringing. She also takes part in working out the specialized software for computer music devices and in application of this software in pedagogical processes. Her developments and researches also belong to the field of musical pedagogics and musicology, musical Informatics, computer modeling of processes of musical creativity, timbre programming, art of performing skills and arrangement on electronic musical instruments, creative work in the field of computer music, mathematical methods in musicology.

Prof. Dr. Gorbunova is Chairman of the Organizing Committee of the international research and practice conference Contemporary Music Education, Chairman of the Organizing Committee of the international research and practical conference Music Computer Technologies in the System of Contemporary Education. Dr. Gorbunova is a member of the Jury of national and international competitions of musical creative works, including Electronic Palette (Saint-Petersburg), Music and Electronics (Moscow), Music of the XXI Century (Moscow / Saint-Petersburg), International Festivals and Competitions Musical Electronics and Multimedia (Moscow / Saint-Petersburg), Clarine of the XXI Century (Saint-Petersburg), The World of Art without Borders (Saint-Petersburg, Russia - Szeged, Hungary), Bridge of Friendship (Dortmund, Germany), All-Russian Competition of Electroacoustic Music DEMO (Saint-Petersburg). She is a member of Editorial Boards of International Journals: Music Scholarship / Problemy Muzykal'noj Nauki (SCOPUS), The World of Science, Culture, Education / Mir Nauki, Kul'tury, Obrazovaniya, Electronic international scientific journal of music and sound in electronic mass media, film, Internet, and multimedia MEDIAMUSIC. Prof. Dr. Gorbunova has developed first ever course in Music, called Music Computer Technologies, which has been offered under the Bachelors of Arts and Sciences (BASc), , which in 2004 carried out student recruitment in different regions and educational institutions of Russia

and she also leads post-graduate courses "Music Computer Technologies in Education" available under the MA in Music Education, since 2006. Prof. Dr. Gorbunova supervises a number of doctoral and post-doctoral students (more than 30) and lectures on Music Computer Technologies and Information Technology in Music. She supervises research in various directions, among them there are: Theory and history of culture, Music Art, Information system and processes, Theory and methodology of professional education, Mathematical modelling, numerical methods and program systems, Theory and methods of education and upbringing (in Music, Informatics, natural sciences). The research results of Prof. Gorbunova were published in over 300 refereed publications including 48 books and 255 papers in journals and conference proceedings. Awards and honors: 2003 - Gold medal of the all-Russian Exhibition Centre (former VDNKh); 2005 - Silver medal of the all-Russian Exhibition Centre (former VDNKh); 2009 - Gold medal of the all-Russian Exhibition Centre (former VDNKh); 2009 - Diploma of the winner in the nomination «New educational technologies in ICT environment» of the all-Russian creative contest of scientific-technical solutions, educational products and services in the field of Informatization of the innovative-educational complex «Music computer technologies in the system of modern education»; 2010 - Grand Prix of International Congress-exhibition «Global Education - Education Without Borders»; 2010 - Diploma of the 11th all-Russian forum «Educational environment - 2010» for the project «Digital educational resources «Music computer technologies in education» in nomination of «Creative Competition of scientific developments, innovative solutions and programs in the field of higher vocational education» and many others; 2011 - Laureate of the Prize of the Government «For Outstanding Achievements in the Field of Higher and Secondary Professional Education»; 2013 - Honorary Worker of Higher Professional Education of the Russian Federation.