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Music Computer Technologies in the System of Contemporary Musical Education: A Research in the Field of Terminology

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Abstract*: *Abstract. Music computer technologies is an independent section of modern information technology, the software and hardware complex of which allows performing operations with sound, creating and editing music material, forming and improving the music and educational process. The development of a methodology for mastering this toolkit, as well as the developing researchers' international interaction, pose a problem for pedagogy to develop and use a unified terminological apparatus that most accurately and fully characterizes this phenomenon. The article proposed by the authors aims to identify opportunities for generalizing terminological developments that exist in this area in various research and pedagogical schools and traditions.

Keywords*: *methodology of science and humanities, music computer technologies, scientific terminology.

I. INTRODUCTION

Being witnesses and participants of the process of the society digitalization, we observe the development of information technology that penetrate all life spheres - everyday routine, production, social and interpersonal communication, etc. Nowadays, the urgent pressing questions include mastering these technologies and studying potential consequences. These problems confront theorists and practitioners of education (general, secondary, inclusive) from the basic and pre-vocational stages to advanced and higher education.

Experts define a range of directions of the education process implementation connected with inclusion of high-technology digital educational technologies into the sphere of music art:

A) designing of methodology of mastering the newfound and continually developing toolkit including, for example, electronic musical synthesizers, custom-made software and hardware (music hardware and software systems, various applications for editing audio / video material, etc.), allows performing operations with music and other kind of material;

B) defining and adding some new content to the process of a competent amateur musician training (music as cultural entertainment and / or a hobby, a kind of relaxation, creative self-expression) and / or to a professional musician training (an instrumentalist, a vocalist, a composer, an orchestrator, a sound technician, etc.); these innovations are actualized both with the help of upgrading of traditional academic subjects (such as "Solfeggio", "Study of Instruments", "Orchestrating", etc.) and due to designing new educational courses ("Computer Music", "Musical Computer", "Electronic Musical Instrument", etc.);

C) designing and application of criterion-evaluative concepts (with the purpose of teaching observation and correction of educational activity on the part of teachers as well as on the part of learners), capable of taking cue from a person's interaction with digital material.

II. THE PURPUSE AND THE PROBLEMS OF THE RESEARCH

Actualization of the directions mentioned above becomes complicated due to the following facts:

- the consumer market is commoditized with numerous versions of computer equipment, application-specific music computer programs (soft), designed to listen to, create and, edit music and audio material;
- some stand-alone national scientific data bases and global systems (first of all, Scopus, Web of Science) collect such a great number of academic literature that it seems impossible for one particular man to study it quite efficiently.

Choosing the one and only international language (English, which has replaced Ancient Greek, Latin and Arabic used in Antiquity and the Middle Ages, now can be considered such a language) necessitates satisfaction of two interconnected terminological regulatory constraints:

A) defining of the unified research vocabulary in a certain field;

B) bring connotation of an English term into maximum conformity with its analogue in another certain language (e.g. Greek, Russian, Chinese, etc.).

While solving one of the most urgent problems and bridging differences in music education (not only those mentioned above but also the ones that are beyond the scope of this article) it is important to design such research vocabulary that:

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- firstly, most precisely represents the essence of a phenomenon included into music pedagogy after it has appeared and developed in the toolkit of information technologies and that can be applied in the sphere of music art, music culture, music communication and music language;
- secondly, can be recognized by the whole world academia, unambiguously understood and used by scientists writing and speaking different languages but conducting their research in one academic field.

We set the goal of this research as to propose such a version of research vocabulary that is unambiguously understood and convenient in scientific use by means of analyzing connotations of the most frequent terms applied in digital information and, on the whole, in computer technologies in music education.

III. MATERIALS AND METHODS

The materials used in the research are publications in international scientific data bases (first of all, Scopus, Web of Science) and academic journals governed by the policy of open access by the theme of scientific sphere "Music pedagogy".

The qualification criteria of the publications analyzed include:

- primary – the theme (the thematic scope) of an academic journal or an article,
- secondary – the key words, the abstract and the full text of the scientific article, from the context of which a reader draws the meaning of the term.

On the one hand, the nature of the defined phenomenon is a special case of information (digital) technologies; on the other hand, it is a subdiscipline which is simultaneously relevant to such spheres of scientific knowledge as computer studies, music studies, psychology, neurophysiology, physics, pedagogy, culture studies, etc.

Two main factors, a) the multidiscipline nature of the phenomenon, b) the format of a small article (unlike the by far larger volume admitted by a monograph) specify our choice of the methodology of implicitly presented assertions (including assertions about the method of information selection and its processing) by way of one or two specific examples.

Research methods include:

- metaanalysis (Pigott et al., 2019 [47]) as the process of the material selection (or as the analysis of the first level) and metaanalysis of the selected material (as the analysis of the second level);
- the method of phenomenological interpretation (Alase, 2017 [5]);
- flash-analysis of linguistic characteristic of the terms and statistical analysis (including on the «coincidence / discrepancy» criterion) applied to the sound and semantics of the English version of the term and the versions in other (A. Khuwaileh, T. Khuwaileh, 2011 [40]; Kertz-Welzel, 2016 et al. [39]).

Thus, we employ the combined quantitative and qualitative analysis, which we consider the most constructive and fruitful in the given research situation.

IV. RESULTS

Scientists from different countries, Australia, Azerbaijan, England, Brazil, Venezuela, Hungary, Greece, Ireland, Spain, Canada, Cyprus, China, Russia, Romania, the USA, Finland, Sweden, South Korea and others, research the educational experience and perform scientific reflection and prognostics of music education applying modern information (digital) technologies.

Academic journals permanently conduct significant constructive work to collect, present and discuss the educational experience on scientific reflection and prognostics in applying technologies (as well as traditional forms) in music education.

The list of academic journals in the sphere or traditional and innovative music education includes: Music Scholarship (Russia), International Journal of Music Education (USA), Information and Communication Technologies in the Musical Field (Romania), Journal of Music Teacher Education (USA), Journal of Research in Music Education (USA), Journal of Music, Technology & Education (United Kingdom), Music Education Research (United Kingdom), Music Perception: An Interdisciplinary Journal (USA), Opus (Brazil), Opcion (Venezuela), Psychology of Music (United Kingdom), Revista Electrónica Complutense de Investigación en Educación Musical (Spain), Action, Criticism, and Theory for Music Education (USA), Research Studies in Music Education (United Kingdom), Utopia y Praxis Latinoamericana (Venezuela) and others.

Among the major studies in this field of education we can: The Oxford Handbook of Assessment Policy and Practice in Music Education (Edited by T. S. Brophy, 2019 et al. [53]), The Learner-Centered Music Classroom. Models and Possibilities (Edit. D. A. Williams, J. R. Kladder, 2019 [52]), Music Learning Today: Digital Pedagogy for Creating, Performing, and Responding to Music (W. I. Bauer, 2014 [7]) and others.

The listed and other works contain:

- on the whole, various approaches to the use of the potential of information technologies in music education;
- isolated special cases (Clements, 2018 [15]), «blended learning in music education» (Crawford, 2017 [19]),
- skills and expertise - teachers' skills (Haning, 2016 [37]), musical competency development in a laptop ensemble (Cheng, 2019 et al. [13]), future work skills (E. Klein & J. Lewandowski-Cox, 2019 [41]), 21st century skills (Csapó и др., 2012 [12]; Logsdon, 2013 [43]; Cslovjecsek & Zulauf, 2018 [20]);
- monitoring – National Core Arts Standards (USA) – www.nationalartsstandards.org and others;
- introduction of new scientific categories: «i-music education» (Chong, 2012 [14]), «e-music» as music with characteristics of activity in the process of its creation, perception, etc. with the use of electronic and network technologies (Plotnikov, 2016 [33]), «human musicality» as a quality of a person belonging to the digital age (Cuervo et al, 2017 [21]);
- as well as different directions in its application:
- inclusive education of the blind (Baker & Green, 2016 [6]; Govorova, Gorbunova [24; 28] and others);

- neurosciences – Exploring the implications of neural processing models on music education practice (Collins, 2013 [16]), Music education advocacy from the point of view of neurosciences (Peñalba, 2017 [46]), psychology (Musical Activity and Well-Being: A New Quantitative Measurement Instrument (Krause et al., 2018 [42]),
- therapy – digital instruments and their use in music therapy (E. Partesotti, 2018 [44]); answers from cognitive neuroscience (Eu. Hernandez-Ruiz, 2019 [38]);
- library science (E. Conor, 2017 [17]) and others,
- new trends in pedagogy – «game-based learning» (A.I. Abdul Jabbar & P. Felicia, 2015 [4]) and others.

In the course of investigations, we find that the content of the term "technology" is used in our educational sphere "Music" in several meanings in word combinations that have the following connotations:
a) as closer in semantics:
- "music technology" (D. B. Williams & P. R. Webster [52; 55]; S. Reese & J. Rimington, 2000 [50]; C. Boehm, 2005 [10] and others);
- «music computer technologies» (I. Alieva, 2018-2019 [1; 2]; E. Bazhukova, 2020 [31]; O. Beluntsov, 2002 [9]; S. Chibirev, 2019-2020 [26; 27]; I. Gorbunova, 2020 [25]; H. Hiner(Heiner), 2019 [29]; A. Kameris, 2020 [30]; S. Mezentseva, 2019 [1; 2]; N. Petrova, 2019 [32]; K. Plotnikov, 2020 [33]; M. Zalivadny, 2018-2019 [35; 36], and others);
- «digital music technology» (R. Crawford, 2007 [19] and others);
- «computer-based technology» (P. Webster, 2001 [55] and others);
b) as more tangentially interrelated on semantics:
- «media technologies» (D. Buckingham, 2003 [11], and others);
- «music teaching via technology» (W. Bauer, S. Reese & P. McAllister, 2003 [8], and others).
We divide into two groups those words (including components of a word combination) that are used to denote and convey the semantics of phenomena that researchers discover in technologies applied in music education:
a) «music», «computer», «technologies»;
b) «based», «digital», «via», «supported».
Collation od the extent of difference / similarity in spelling and pronunciation (regardless of phonetic characteristics, stresses on the certain syllable) is presented in Table 1 («music», «computer», «technology / technologies») and in Table 2 (for «based», «digital», «via», «supported»); in both tables we, taking the English term as a conditional standard, mark in cursive the discrepancy that occurs while switching to another language.
The analysis of the given examples of contextual use of certain words / word combinations shows different levels of understanding of the described phenomenon: for instance, music technology», «music teaching via technology» and others.

Table 1 – The most widely used lexical units to denote the phenomenon of «music computer technologies» in different languages of the peoples of the world.

Language	Term translation version		
English	music / musical	computer	technology / technologies
Arabic	موسيقى [musiqaa]	كمبيوتر [kambyutir]	تـ قـ ذ ية *[almaelumat]*
Armenian	*Երաժշտություն [yerazhshtut'yun]*	համակարգիչ *[hamakargich']*	տեխնոլոգիա [tekhnologia]
Azerbaijani	musiqi	kompüter	texnologiyası
Belarusian	музычныя [muzyčnyja]	кампутарныя [kampjutarnyja]	тэхналогіі [technalohii]
Bulgarian	музикални [muzikalni]	компютърни [kompyutŭrni]	технологии [tekhnologii]
Chinese	音樂 *[yīnyuè]*	電腦 *[diànnǎo]*	技術 *[kējì]*
Croatian	*glazba*	*računalo*	tehnologija
Czech	*hudba*	*počítač*	technologie
Finnish	musiikki	*tietokone*	tekniikka
French	musique	*ordinateur*	technologie
Georgian	მუსიკა [musik'a]	კომპიუტერი [k'omp'iut'eri]	ტექნოლოგია [t'eknologia]
German	Musik	Computer	Technologie
Greek	μουσική	*υπολογιστής*	τεχνολογία
Hindi	*[sangeet]*	[kampyootar]	*[praudyogikee]*
Hungarian	*zene*	*számítógép*	technologia
Icelandic	*tónlistar*	*tölvu*	tækni
Italian	musica	computer	tecnologia
Japanese	*[ongaku]*	[konpyūtā]	*[gijutsu]*

Kazakh	музыка [muzyka]	компьютер [kompyuter]	технологиялар [tehnologïyalar]
Latvian	mūzika	*dators*	tehnoloģija
Mongolian	*хөгжмийн [khögjmiin]*	компьютерийн [kompiyutyeriin]	технологи [tyekhnologi]
Norwegian	musikk	*data*	teknologi
Polish	muzyka	kompüter	technologia
Portuguese	música	computador	tecnologia
Romanian	muzică	computer	tehnologia
Russian	музыкальные [muzykal'nyye]	компьютерные [komp'yuternyye]	технологии [tekhnologii]
Serbian	музичке [muzičke]	*рачунарске [računarske]*	технологије [tehnologije]
Spanish	musica	computadora	tecnología
Tajik	musiqī	kompjuter	texnologija
Turkish	müzik	*Bilgisayar*	teknolojisi
Uzbek	musiqa	kompyuter	texnologiyalari
Ukrainian	музичні	комп'ютерні	технології
Swedish	musik	*dator*	teknik
Yiddish	מוזיק [muzik]	קאָמפּיוטער [kompiuter]	טעכנאָלאָגיע [tekhnologye]

Table 2 – Terms «based», «digital», «via», «supported» that are used to denote music computer technologies in different languages of the peoples of the world

Language	**Term translation version**			
English	based	digital	via	supported
Arabic	رقمي *[ealaa 'asas]*	عبر *[raqamiin]*	المدعومة *[eabr]*	على أساس *[almadeuma]*
Armenian	հիմնված *[himnvats]*	թվային *[t'vayin]*	*Միջոցով [mijots'ov]*	*աջակցությամբ [ajakts'ut'yamb]*
Azerbaijani	*əsaslı*	*rəqəmsal*	*vasitəsilə*	*dəstəklənir*
Belarusian	*заснаваны [zasnavany]*	*лічбавы [ličbavy]*	*праз [praz]*	*падтрымліваецца [padtrymlivajecca]*
Bulgarian	базирани [bazirani]	*цифрови [tsifrovi]*	*чрез [chrez]*	*поддържани [poddŭrzhani]*
Chinese	基於 *[Jīyú]*	數字 *[shùzì]*	通過 *[tōngguò]*	支持 *[zhīchí]*
Croatian	*utemeljeno*	digitalno	*putem*	*podržanih*
Czech	*založené*	digitální	*prostřednictvím*	*podporováno*
Finnish	*perustuu*	digitaalinen	*kautta*	*tuettu*
French	basé	*numérique*	via	*pris en charge*
Georgian	დაფუძნებული *[dapudznebuli]*	ციფრული *[tsipruli]*	მეშვეობით *[meshveobit]*	*მხარდაჭერილი [mkhardach'erili]*
German	basierend	Digital	via	*unterstützt*
Greek	βασισμένο	*ψηφιακό*	*μέσω*	*υποστηρίζεται*
Hindi	*[aadhaarit]*	[dijital]	*[ke maadhyam se]*	*[samarthit]*
Hungarian	*alapú*	digitalis	*keresztül*	*támogatott*
Icelandic	*byggir*	*Stafrænt*	*með*	*stutt*
Italian	basato	digitale	via	supportato
Japanese	[bēsu]	[dejitaru]	*[keiyu]*	[sapōto]
Kazakh	*негізделген [negizdelgen]*	*сандық [sandyq]*	*арқылы [arqyly]*	*қолдайды [qoldaydy]*
Latvian	balstīta	digitālā	*caur*	*atbalstīta*
Mongolian	*суурилсан [suurilsan]*	дижитал [dijital]	*дамжуулан [damjuulan]*	*дэмждэг [demjdeg]*
Norwegian	basert	digital	via	*støttet*
Polish	*oparty*	*cyfrowy*	*przez*	*obsługiwane*

Portuguese	baseado	digital	via	Suportado
Romanian	bazat	digital	via	suportat
Russian	*на основе [na osnove]*	*цифровой [tsifrovoy]*	*через [cheris]*	*поддерживается [podderzhivayetsya]*
Serbian	базиран [baziran]	дигитални [digitalni]	*путем [putem]*	*подржаних [podržanih]*
Spanish	basado	digital	vía	*compatible*
Tajik	*asosi*	*raqamī*	*tavassuti*	*dastgirī*
Turkish	*tabanlı*	dijital	*Üzerinden*	*desteklenir*
Uzbek	*asoslangan*	*raqamli*	*orqali*	*qo'llab-quvvatlanadi*
Ukrainian	базований [bazovanyy]	*цифровий [tsyfrovyy]*	*через [cherez]*	*підтримуваний [pidtrymuvanyy]*
Swedish	baserat	digital	via	*stöds*
Yiddish	רט [bazirt]	דיגיטאַל [digital]	דורך *[durkh]*	געשטיצט *[geshtitst]*

In the linguistic part of our analysis we take into account the variety of methods to translate terms according to the specific character of "the connotation of a respective foreign language":
- the use of the functional equivalent, typical of the cultural and language traditions of the country (cultural / functional equivalent),
- the literal translation of every word (translating literally / word by word),
- borrowing of the original term from the source language (transcription as the use, SL/source-oriented strategies, unlike TL/target-oriented strategies; authors' note);
- coinage (neologism creation process) [3, p. 102] (A. Anisimova, 2002);
- as well as used in the national linguistics «untranslated borrowing, transformational translation, descriptive translation, or interpretation, and calquing» [2, pp. 43-44];
- and others,

V. DISCUSSION

The methodology to analyze the material in paragraph 4-3, implies that English variants are taken as the conditional transfer standard,
- which, firstly, is grounded by the fact that the English,
- which, secondly, is proved by the fact that academic literature on the analyzed topic is found in the highest volume in the English language.

In 34 cases included in the sample (except for English variants):
- for the word «music» – 25 cases or 73 % coincidence (discrepancy – in Arminian, Chinese, Croatian, Czech, Hungarian, Icelandic, Mongolian and Hindi);
- for the word «computer» – 22 cases or 65 % coincidence (discrepancy – in Arminian, Chinese, Croatian, Czech, Finnish, Hungarian, Icelandic, Latvian, Norwegian, Serbian and Swedish);
- for the word «technology / technologies» – 30 cases or 88 % coincidence (discrepancy – in Arabic, Japanese, Chinese and Hindi);
- for the word «based» – 14 cases or 41 % of close or more remote coincidence (discrepancy cases are marked in cursive – see Table 2);
- for the word «digital» – 18 cases or 53 % coincidence (discrepancy cases are marked in cursive – see Table 2);
- for the word «via» – 8 cases or 23 % coincidence (discrepancy cases are marked in cursive – see Table 2);
- for the word «supported» – 4 cases or 18 % (discrepancy cases are marked in cursive – see Table 2).

Consequently, at the level of graphics understanding (for some languages – in transcription) and sound understanding for one and the same sample of the languages:
- the word combination «music computer technologies» has average dispersion equal to 25;
- sometimes the introduced into the research vocabulary words «based», «digital», «via», «supported» have average dispersion equal to 66, which is 2,5 bigger than the indices of the previous group.

In accordance with the obtained results (p. 4-1, p. 4-2, p. 4-3), summing the preliminary conclusions after each paragraph we assert that:
- there is a mainstream on this topic in scientific publications (paragraph 4-1);
- the semantics (connotation volume) for the term 'technology' can be found in different variants of usage (word combinations, offered at a certain moment and further used precisely or with some additions / outtakes (paragraph 4-2);
-there are benefits for interaction of multilingual scientific community to use word «music computer technologies» (for example, in comparison with «based», «digital», «via», «supported») to define technological IT-toolkit, used in music education (p. 4-3).

The research vocabulary used in "music computer" direction of music education (taking into consideration the extent of freedom the authors get to define technologies) is formed, to some extent, not only on the basis of some authors' authority but also due to publishing activity of a number of researchers and editorial staff.

5-4. In the context of further research on this topic scientific community and individual researchers can:
- independently or collaboratively, in the course of their scientific or pedagogical activity, understand as technology / technologies some particular volume of the sum of connotations that are included into the terms from the list: «music technology», «music computer technologies», «digital music technology», «computer-based technology», «music teaching via technology»;
- propose a well-grounded variant or the term and agree about its meaning and usage in this general meaning.

5-5. We accept the J. Dorfman's opinion (2018) who insists on considering the unity of prospects and risks that include:

- realized and untapped capacity of technological way of music education, i.e. the opportunities of simultaneous comprehension of music material via visual, audio and kinesthetic canals while teaching music by means of technologies; opportunities (and some limits) of distant mastering of music language, music culture and others;
- limits and educational risks, for example, language difficulties of the application interface in other languages; pseudoscientific and unscientific "methodological recommendations", posted in the net and available for a user with underdeveloped critical thinking; spam and similar untargeted content, sometimes accompanying the on-line materials; prevalence of technological comprehension of music over its spiritual foundation and others;
- we urge to regard with self-conscious optimism and obligatory age limit restrictions the «Open online resources and visual representations of music: New affordances for music education» (C. Schmidt-Jones, 2018 [51]).

VI. CONCLUSION

A. Applications of the music model

1) The summarizing conclusion of this research implies that a number of arguments allows us to acknowledge the term "music computer technologies" as the optimal one for international usage:
- it is close in spelling and sound to the most other languages (which is clearly seen from the list of the materials we made…),
- it contains the highest volume of connotations (in comparison with other proposed definitions) (paragraph 5-2).
2) We can draw other important conclusions that are based on the analysis of the given material in the conducted research:
A) The usage of music and computer technologies is estimated as the one that has great prospects:
- new values in music education (H. Partti, 2014 [45]);
- search for «trans-truth» in the epoch of «post-truth» (C. Ramírez-Hurtado, 2017 [49]);
- a new extended version of the concept of integration of educational spheres in STEM Education {Science, Technology, Engineering and Mathematics, further - STEAM Education}, which are completed by educational sphere "music" STEAMM {Science, Technology, Engineering and Mathematics+Music}[23].
B) The estimation of MCT has duality that includes potential and limits (paragraph 5-5), which can and must be the topic or a future individual research.

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Irina B. Gorbunova was born in St. Petersburg (Leningrad), Russia. DipMus, Special Music Higher School of the St. Petersburg State Conservatory named after N.A. Rimsky-Korsakov; BSc in Computer Science: Information Technology, Computer Science and Multimedia, Leningrad State University, Ussurisk State Pedagogical University; MA in Education, the Herzen State Pedagogical University of Russia; PhD in Information Technology and Pedagogical Sciences, the Herzen State Pedagogical University of Russia, St. Petersburg, 1989; Doctor degree: Doctor of Pedagogical Sciences and Information Technology, the Herzen State Pedagogical University of Russia, St. Petersburg, 1999. Dr., Full Professor, Chief Researcher of the Educational and Methodological Laboratory *Music Computer Technologies* at the Herzen State Pedagogical University of Russia, St. Petersburg; hold the degree of Honorary Worker of Higher Professional Education of the Russian Federation.

Work experience:

1990 – 2010 - Associate Prof., Professor of the Department of Information Technology of the Herzen State Pedagogical University of Russia, St. Petersburg;

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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.) 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);

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Prof. Dr. Gorbunova is a Chairperson of the annual Iinternational Research and Practical Conference *Contemporary Musical Education* held since 2002; Chairperson of the annual International Research and Practical Conference *Music Computer Technologies in the System of Contemporary Education* held since 2007.

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 21st 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).

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), and she also leads post-graduate course "Music Computer Technologies in Education" available under the MA in Music Education.

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 Ssystems, 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 49 books and 277 papers in various scientific journals.

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.

Konstantin Yu. Plotnikov was born in 1967, Irkutsk, Russia.

2019 - Senior Researcher of Herzen State Pedagogical University of Russia (St. Petersburg);

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2011 - 2014 – PhD student at the Herzen State Pedagogical University of Russia, St. Petersburg

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Since 2012, Konstantin Plotnikov has been participating in the annual International Research and Practical Conference Contemporary Musical Education organized by the Education and Methods Laboratory Music Computer Technologies of the Herzen State Pedagogical University of Russia and the St. Petersburg State Conservatory named after N.A. Rimsky-Korsakov. His works (more than 80, includes 3 monographs) have been published in various scientific journals and editions.

Konstantin Yu. Plotnikov is the winner of International Educational & Musical Competitions: World Championship of Folklore (Bulgaria / 2011); Winner of the Russian Federation Government Prize in Education (2011); Music Teacher XXI (Magnitogorsk / 2008) and others.

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Main publications: Plotnikov K. Yu. Methodical system of training to computer science using music and computer technology: monograph. St. Petersburg: Lema, 268 p.; Gorbunova I. B., Plotnikov K. Yu. Music-Related Educational Project for Contemporary General Music Education of School Children. International Journal of Innovation, Creativity and Change. 2020. Vol. 12. Issue 2. p. 451-468; Gorbunova I.B., Plotnikov K.J., Heiner H. Music Computer Technologies as an Integrative Networking Educational Environment. Revista Praxis Educacional. 2020. V. 16. No. 37, pp. 483-495.; Plotnikov K. Yu. Monitoring the student’s music-related advancements. Vestnik of Orenburg state pedagogical university. Electronic Scientific Journal, No. 3 (19). p. 75–93; Plotnikov K. Yu. Pedagogical support for the development of Musical and Computer Technologies students (as the elimination of the educational risks). The Edge of Knowledge. Electronic Scientific Journal. 2017. No. 4. Plotnikov K. Yu., Galchenko M. T. The model “Educational heals musical environment” for children's summer camp. Modern scientific researches and innovations. Electronic Scientific Journal. 2016. No. 7 (63). p. 407–414; Plotnikov K. Yu. The potential of singing activities in development of adolescents` self-reliance. The science of person: humanitarian researches. 2016. No. 1 (23). pp. 161–170. editions.

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