REVIEW

of Prof. Dr. Simo Lazarov

of the dissertation of

ALEKSANDAR LYUBOMIROV BAYCHEV

on the topic:

"MUSIC AND PEDAGOGICAL TECHNOLOGY FOR THE CREATION OF ALGORITHMIC COMPOSITION "

for awarding the educational and scientific degree "Doctor"

in the field: 1. Pedagogical sciences, Professional field: 1.3.Pedagogy of teaching in… (Methodology of teaching music).

The presented dissertation contains 168 pages, distributed in an introduction, four chapters, conclusion and conclusions, self-assessment of the contributions and two appendices with bibliography with 156 sources, of which 99 - in a foreign language. Three author's scientific publications on the topic of the dissertation are also cited.

According to the doctoral student, "The current study is provoked by the relevance of the studied problem and its practical significance. It is motivated by the need to optimize the conditions for effective learning of students through the application of science-based music-pedagogical technology to create an algorithmic musical composition. The real focus of the research that this paper aims to describe revolves around the presumption that using the capabilities of modern technology to create algorithmic music as a means of teaching students can be a path to inspiration. This idea also appears as a result of the knowledge acquired in the process of learning in a software environment based on musical laws.

In the first chapter the thesis about the theoretical and methodological bases of the algorithmic composition is developed and the **main characteristics** for the development of the algorithmic music and the **fractal music** with the main methods and means by which it is created are considered.

The definition of algorithmic music is derived on the basis of the quoted literature sources. The leading concepts in algorithmic composition through code-graphic transformation are clarified. Establishing a direct relationship between the initial data of the mathematical model and the musical parameters is a leading principle.

The algorithms are correctly classified in four main categories which are used in composing music: stochastic processes; recursive; based on rules and genetic algorithms. The general principles of algorithmization of computer-generated musical compositions are considered, as well as the two principles of melody modeling are outlined. The skillful use of the research of world authors proves the truth of further reflections on the creative intentions of the programmer-musician.

This chapter also provides detailed historical information on the development of the algorithmic process of musical composition over the years. The methods of composing the composer and theorist Guido D'Arezzo, Marzano, the music theorist Franco from Cologne, the musicologist Friedrich Ludwig, the French composers Philippe de Vitry and Guillaume de Masho, the renaissance composer Josquin Depp, the American musician Johann Fieger, Johann Fieger Schillinger and his students Anton Webern and Alban Berg, Josef Matthias Hower. It is emphasized that the composers Boulez, Xenakis, Lansky, Hiller are considered to be the ancestors of algorithmic music. The mid-1960s were marked by Paul Lansky, Ledger Hiller, Andrei Markov and Piotr Novikov, composers David Clark Little and Gary Nelson, the founder of serialism and a prominent representative of stochastic music, Stockhausen. It is marked that the term **stochastic music** is introduced by Ianis Xenakis, and algorithmic music reaches fractal music, which is based on fractal algorithms.

The doctoral student brings up the thesis that **fractal geometry** is defined as the **geometry of chaos**. It is also argued that according to chaos theory, nature is very complex and is a theory of ever-changing complex systems based on the mathematical concept of recursion, whether in the form of a recursive process or as a set of differential equations modeling a physical system. The term **chaos** was coined

by the American mathematician Jim York, and Benoit Mandelbrod coined the term **fractal**. The application in the three main areas of music: composition, sound synthesis and analytical research is shown in the exposition on this topic, in which Alexander Baichev analytically and consistently examines the development of fractals in the context of music. Examples are given of the work of Monojit Choudhury and Pradipta Ranjan Ray, Jean Beran, the theory of Richard Voss, John Clark.

The doctoral student continues with the historical justifications for the study of the fractal nature of music. These are the studies of M. Gardner, M. Schroeder, J. Longing, S. Mason, M. Sefley. And with analytical reasoning, we come to the conclusion that algorithmic music is actually music created from fractals. By computer generation fractals can be converted into visual and audio processes. As the doctoral student writes, "There are many phenomena in music that have the properties of fractality." Examples are given: "Larry Solomon connects Serpinsky's triangle with the shape of the rondo, and through Koch's snowflake generates polyphonic works." Through such research, the universal is found in musical works. The doctoral student came to the conclusion that the main concept in algorithmic composition is code-graphic transformation. The main ways to create algorithmic music as the most used categories of algorithms that can be applied to musical composition are: stochastic processes (probability functions, Markov chains); recursive (2D and 3D chaotic systems, fractals, nonlinear equations, number theory); spectral noise; cellular automata; based on rules (L-systems); genetic algorithms. probability functions, Markov chains

This chapter also mentions the main ways to create algorithmic music: algorithms that can be conditionally divided into six intersecting groups in terms of structure and way of processing musical data: mathematical models; knowledge-based systems; training systems; grammar; evolutionary methods; hybrid systems. Researchers describe six algorithms developed for these programs that meet specific aspects of music such as: L-systems, cellular automation, graphic image conversion, formula composition, genesis composition, behavioral composition. The above gives

grounds to draw scientific conclusions about the existence of algorithmic music in general.

Interesting facts related to the history of the creation of algorithmic music and finding natural relationships between construction and its construction are presented. The basic technological principles are indicated, through which again a comparison between the ideas is sought. The doctoral student argues that the synthesized sound can become for the programmer - composer in the carrier of musical thought or if the idea came in advance - in its implementer. The associative way leads to the conclusion that the idea of creating a musical model is provoked and shaped by the circumstances in which it arises, and the idea of composition is realized according to the chosen approach and the available technological tools and software.

The historical study of the development of algorithmic music is done with skill and a high degree of knowledge. Interesting are the conclusions that focus on the fact that: in the relationship that is created between the programmer - composer and selected software there are "relationships", which makes the algorithmic composition "alive and animated" by the energy invested in it. " And in order to liberate the creative beginning, in which such animation is rooted, sincere music-making is needed. The study provides guidelines to prove just that.

The second chapter presents the setting of the research, the organization and the methodology of the research. A characteristic of the music-pedagogical technology is made. the applications of music-pedagogical technology in music education are considered. The **object** and the **subject** of the research are well defined. The **aim** of the research is to establish the applicability and effectiveness of the developed music-pedagogical technology in music education at school, and to achieve this goal the relevant tasks are set. The working **hypothesis** includes assumptions related to the conduct of a productive music-educational process in which students master the knowledge, skills and competencies to create an algorithmic composition and work with a new type of software tools.

The problems in assessing students are also discussed. Music made with computer technology strictly adheres to its concept and its creation requires new

methods and approaches with full control over the creation of the composition. The dissertation describes the influence of different evaluation characteristics. Aleksandar Baychev emphasizes that "The analysis of these data shows that the results of the evaluation of all indicators and criteria are interpreted correctly and the test system guarantees high repeatability, i.e. high stability of the obtained result". In the development of the theses of the whole dissertation and in connection with the various methods and means the analysis of the author is correct and shows that with developed musical hearing the prototype of the model often leaves a memory in the mind.

This chapter describes music education specifically focused on innovative software. It is carried out according to curricula developed in accordance with the requirements for learning outcomes at the end of each educational stage. It is very appropriate the decision of the doctoral student to present in tabular form the curriculum in music curricula 4-7 grade, so that we can orient ourselves in the place of each step of the educational process.

The organization and the contingent of the research are given. The research methods and the methodology for evaluating the students' achievements in creating an algorithmic composition are shown. The criteria for establishing the level of mastered knowledge, skills and competencies for creating an algorithmic musical composition are presented. The indicators according to which the assessment of knowledge, skills and competencies is performed are detailed. They are classified in the appropriate order. The most important thing is the knowledge, skills and competencies for choosing the function of the selected musical instruments, according to the style of the composition and the assessment according to the completeness of the composition.

It is given a specific example of how the experiment is performed. "87 students from 7th a, 7th b grades from Hristo Botev Primary School and 7th a, 7th b grades from Khan Asparuh Primary School, Dobrich are participating in the experimental training."

The whole research is based on **statistical methods** for processing the results of the studied students, which gives it scientific value. It is worth noting another statement of Aleksandar Baychev, concerning the means and methods of creating sound. This helps students begin to understand music in a completely different way. This will provoke the desire to start and explore the very genesis of music, and to spread music in a vast and increasingly interesting scientific space. A space where music is created with the help of electronics, based on technological processes.

All this should be appreciated with the suggestion that the electronically generated sound in the algorithmic composition exists on the basis of generating processes and each new variation is a mini similarity of the whole, which causes a chain of increasingly different similarities. Music has never been more understood through the principles of technology than it is today. That's why today the music created with algorithmic sequence software is new, electronic sounding, whimsical, made differently and sounding different.

The third chapter focuses on the creation of an algorithmic musical composition in the light of a methodological model, the implementation of which requires the presence of certain knowledge, skills and competencies.

A good example is the training with the WolframTones generator based on the pedagogical technology for creating an algorithmic composition. The software tools through which the compositions of the students are realized are considered. The set of rules gives the direction of realization. Each composition is created by running a program. The choice of WolframTones with a program that mimics a cellular automaton is appropriate given the level of learners.

Numerous figures explain the action of WolframTones. **The pedagogical technology** for creating an algorithmic music composition with WolframTones is suitable for the purpose. The steps of sequence are presented in detail: Choice of musical style of the composition, algorithm for creating the composition, choice of musical instrument for each part of the composition. It is important to determine the mode and duration of the composition. The last step is the preservation of the resulting musical composition. Creating an interactive environment is a fun and

enjoyable task and positively stimulates learners, predisposing them to more active participation in the musical process. The doctoral student has correctly chosen this generator as an easily accessible and at the same time functional device for creating algorithmic music.

This solution is correct because WolframTones is an extremely powerful software with great capabilities. An excellent overview of the approaches to creating a computer sound environment has been made. True and accurate estimates of the trends and characteristics of these new approaches are given. Problems and ways to solve them are outlined. It is proved that many phenomena in the creation of algorithmic music show the same principled approach in their structure, as one of the main properties that are found as similarities between different software environments.

In the **fourth chapter** the results of the initial and final stage of the experimental training are presented, analyzed and summarized. A comparative analysis of the results obtained by the studied students was made. The purpose and tasks of the experimental verification are carried out according to the relevant criteria and indicators.

The graphical presentation of the results convincingly speaks of the right direction of training and the results obtained prove this. Looking at the results of the training, it is very clear that the performance of students at the end of the experiment is better and the results are higher than at the beginning. Based on a comparative analysis of the results of experimental training, it is clear that the approach is correct. The comparative analysis by indicators is made in detail and in detail.

The analysis of the data shows that as a result of the training with the WolframTones generator, the students have improved their knowledge, skills and competencies for musical instruments. Based on this knowledge at the end of the experiment, they can consciously choose musical instruments and their functions according to the style of composition. In a well-balanced sequence, the details and problems of modeling algorithmic compositional procedures are considered, in which

the choice of approach to the methods of composing this music is leading. The techniques and application of models are presented.

In the **conclusion** a successful summary of the creative achievements in the dissertation is made, and the main suggestions are correctly presented, such as:

Basic methods for creating algorithmic music have been studied in order to find the most optimal system in the available studio conditions in order to create a music algorithm. This study includes the most well-known methods used for composition. Methods for creating music are studied, as well as specific characteristics that determine the creation of this music.

This study provides prerequisites for creating a foundation for building a coherent theory for the creation of a universal musical work. This process is a kind of information that can be presented as a stream of data that outlines this music and as inspiration. This implies studying these data for years.

Computer technology is the means by which music began to be translated into other languages - it began to be programmed, visualized, digitized.

There is a well-formulated goal and objectives of the dissertation, which guarantee promising and valuable research. The main thesis that the author announces at the beginning of his research has significant scientific potential. It is rightly stated that the set conditions for performance in accordance with the thesis that the creation of such compositions can be used as a means of training and inspiration.

As the doctoral student points out: "The analysis of the contemporary literature related to algorithmic composition, the limited number of publications in Bulgarian and the need to modernize the learning process are the basis and motivation for choosing the topic and research."

The analysis of the research results confirms the working hypothesis, also shows that the purpose of the study - to establish the effectiveness and applicability of music-pedagogical technology to create an algorithmic composition, has been achieved and the tasks - completed. The reason for this statement is the high results

achieved, which are due to the conducted training and mastering the knowledge, skills and competencies for creating a musical composition.

In the dissertation a correct presentation of the methods for creating an algorithmic composition is made. True and accurate estimates of trends and characteristics of these methods have been made. Problems and ways to solve them are outlined.

Music-pedagogical technology creates favorable conditions for music education in the school education system through the application of modern technologies. Simultaneously with the acquisition of knowledge, skills and competencies, students develop their musical-auditory, musical-cognitive, emotional-evaluative and musical-creative abilities.

In the total of the eight **contribution moments**, divided into two categories (**Theoretical and practical significance**), the author's claims are formulated. The formulated contributions include: *development of science-based music-pedagogical technology; analyzing the relationship between algorithmic music and technology; arguing the application of the developed music-pedagogical technology in music education; a training proposal with a new type of software that is easy to learn and stimulates students to actively participate in the learning process.*

When using music-pedagogical technology, students acquire knowledge, skills and competencies about music, music art and modern technologies, gain subjective musical experience.

The music-pedagogical technology is original and practically applicable in the education of students who do not have special musical training and who can create a musical product with an applied character. The technology can serve as a methodological guide for a wide range of users.

The bibliography contains 156 **literature sources**. They are appropriately used and appear as an analytical foundation on the research topic.

An **application** is included, which contains tables, diagrams and 87 student compositions, which are the result of the work in the process of experimental verification.

Taking into account the above arguments, I believe that Aleksandar Lyubomirov Baychev fully meets the requirements for obtaining an educational and scientific degree "Doctor" in the field: 1. Pedagogical sciences, Professional field: 1.3. Pedagogy of teaching… (Methodology of teaching music) under the Law on the Development of the Academic Staff of the Republic of Bulgaria and fully deserves to be awarded.

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Sofia

Reviewer:

/ prof. Dr. Simo Lazarov /