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Audio engineering books as an object of research for improve curriculum of technically oriented music education

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Abstract The use of information and communications technologies in music education at primary schools of arts in Slovakia takes place especially within the Music and the Computer course. This course has been taught at schools since 2006 but no detailed methodological guidance has been written for it yet, nor have the overall contents of the course been designed. This paper presents the outcome of a research that mapped sixteen specialist texts focusing on education in the field of audio production. Based on these, it presents a proposal for the contentual concepts of education and a proposal for the structure of the curriculum of the Music and the Computer course.

Key words: audio, education, music

1. ANALYSIS OF THE CURRENT STATE OF THE MUSIC AND THE COMPUTER COURSE

The use of modern digital didactic tools in music education has had a tradition in Slovakia since about 1999 when the Infovek [Info-Age] project came into being as a result of the activities of a non-profit organization called Asociácia Projektu Infovek [Association of the Infovek Project]. The aim was to modernize and support the teaching process with ICT. The website of the project, www.infovek.sk, was developed in the same year and a hardware infrastructure began to be built at 79 schools. In March 2000, the Tender Committee of the Ministry of Education of the Slovak Republic selected 150 schools for the Infovek project and, in August 2000, the training of teachers started. Asociácia Projektu Infovek, in collaboration with the Ministry of Education of the Slovak Republic, organized an Infovek Summer School, which was attended by 120 teachers. The project turned out to be a success at that time already, which is documented by the approval of the proposal for raising the budget for the project for 2001 to a total amount of 210 million Slovak crowns. [7] Currently, the information centre in the form of the website of the project does not function any more. The follow-up Infovek 2 project is to solve only the possibilities of the Internet connection of schools and does not deal with the form and contents of education in more detail. At universities, ICT were introduced into music education e.g. through the MOODLE online interface, by which education currently takes place at some music departments; its success is documented e.g. by a research [10] carried out by Alena Čierna in the course of several years.

Besides the online interface, which is an ideal information platform for computer-assisted instruction, several textbooks were written. One of the first of these was a methodological guide focusing on computer-assisted instruction in music education called Introduction to Working with Music Software. It was published in 2006 [11] and, in its introduction, the author calls attention to the fact that the textbook is meant for musically educated individuals who have no experience with using music software yet. More recent methodological works were written in 2013 [6, 2] but these focus only on computer programs with minimum creative potential (intonation and rhythm, writing notation) and they are primarily for computer-assisted instruction.

A lot more complex approach to the use of music software and technology is required by specialized courses, such as Music and the Computer. This course requires innovative approach and creativity from the teacher as well as pupils, and these are the main features of the teaching process. In Slovakia, this course has been taught since 2006. The project of this new course was novel and ambitious at the time, similarly to the keyboard course earlier on. However, the contents of the curriculum and the syllabus have not been updated for the past decade and, most probably, the course currently does not reflect the technological trends and innovative approaches to music education. The above assumption is based on reports on the number of pupils attending the course at primary schools of arts. The reports are registered at the Slovak Centre of Scientific and Technical Information of the Slovak Republic (hereinafter referred to as SCST SR) and are publicly available.

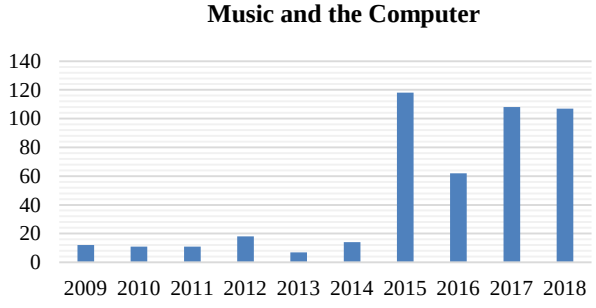

Chart 1 Number of pupils attending the Music and the Computer course in the years 2009 – 2015

Chart 1 depicts the number of pupils attending the Music and the Computer course in the respective years. It shows their total number at all the primary schools of arts in Slovakia. The SCST SR keeps similar statistics about the enrolment of pupils until 2009. The extraordinarily low interest in the course is interesting also for the reason that the curriculum and the syllabus of the course approved by the Ministry of Education of the Slovak Republic [21] impose the completion of level 1 of the primary study of keyboard playing as a condition for joining the Music and the Computer course. Despite the rapid growth of interest in the course in 2015, the change is negligible compared to the number of students attending the Keyboard course (over 4,000 every year from 2009 onwards). At present, the Music and the Computer course is not attractive for several reasons, the most significant being the inadequate specification of the learning objectives and the contentual inconsistency of the course. If the course is to train and educate individuals to have knowledge, skills and abilities in the field of working with sound, its contents must be based on the principles of audio production. The above facts are the main reasons why the current curriculum and syllabus should be changed, although a deeper analysis of the document reveals several other reasons, too.
The curriculum and the syllabus of the Music and the Computer course is divided into three types of study programmes according to the requirements for the pupils' skills at playing a musical instrument. All the programmes have a fixed duration of the course for three years and the age limit of the applicants is set to 14 years. A detailed analysis of the curriculum of the course reveals the areas in which it currently does not comply with several standard didactic methods. The most severe of these appears to be its non-compliance with the method of induction which first works with specific and known elements and progresses to general notions, formulas, or even specialist terminology.

In the first year, the Music and the Computer course begins with group instruction where the terminology, technology and technological processes are introduced. However, working with music software, which is a specific and exactly describable activity, cannot be included in here. Conversely, technological processes and the use of specialist terminology belong to the category of abstract notions and, moreover, they are completely subjective in audio production. The second and the third year focus on doing practical exercises, improving instrument playing skills, and composing. Here, instruction focuses exclusively on the communication of the MIDI device with the computer. In this form, the curriculum and the sequence of the syllabus is more suitable for an experienced musician who wants to start using digital technologies for composing or performing. What appears to be problematic with the current curriculum is how to motivate the pupils. Motivation is an indispensable part of the learning process which subsequently activates the pupils and arouses their interest in the subject even outside the lessons. Focusing too narrowly on MIDI technologies and theoretical knowledge does not enable the pupils to familiarize themselves with the system of audio production from the simplest activity, that of recording sound using a microphone and working with it. MIDI technologies do not motivate the pupils adequately because they represent an abstract field of working with sound. By creating sound recordings and editing the sound, pupils can directly experience the essence of audio production and this activity activates them, too.

Although the curriculum document mentions working with audio recordings, it keeps it only as a supplement and states that it is a demanding issue which requires a separate subject of study. [21] The preference of MIDI technologies, and not only in education, may have a more prosaic reason than that of only following the current trend. We must realize that the majority of their users, for whom these technologies are developed and improved, do not work under proper acoustic conditions. They are mostly amateurs and enthusiasts working at home. Therefore, MIDI technologies are constructed to be effective both financially and spatially. Mostly, their users can do with a computer and headphones or, in better cases, with a keyboard in addition. Definitely, educational institutions, and mainly primary schools of arts, also benefit from this effectiveness.

Another problem of the Music and the Computer course is the unclear and incomplete specification of the technical equipment. It consists primarily of audio output devices whose use is closely connected to the form of group instruction in the first year. Group instruction cannot be carried out in any other way than with headphones but the authors do not deal with the issue of audio output devices in the syllabus. In music education, this issue is often overlooked. [8] Moreover, the use of headphones is very dangerous because it can damage hearing. Portnuff and Fligor [12] called attention to this fact already in 2006 at an international conference dealing with the issue of hearing loss and hearing impairment in the case of young listeners. Depending on the model of the headphones, at their maximum volume, they can be used without risking hearing impairment only for 5 to 18 minutes. The acceptable volume of 85 dB is hard to control and achieve under the teaching conditions at primary schools of arts. The technical facilities required for the course consist of a MIDI keyboard, a computer, a sound card and software in the form of multitrack recording software and scorewriter. When creating a new curriculum and syllabus for the course, the requirements for the technical facilities must be updated in terms of modernizing the teaching process and improving the quality of the conditions in which pupils learn.

The curriculum and the syllabus of the Music and the Computer course includes a characterization of the profile of its graduates and the scope of knowledge and skills they must have. At present, the graduate profile is defined generally and, besides skills at working with technology and knowledge of music theory, it includes the development of performance skills at playing the keyboard or even improvisation skills. Although the course is closely connected to the Keyboard course and is directly linked to its completion, it may not be acceptable to develop performance skills in the Music and the Computer course. Pupils must be able to create and edit sound recordings in various forms, and this activity usually does not take place in real musical time.

Creating a high-quality audio project, which is the condition for the completion of the course, cannot be bound by demonstrating performance skills at playing an instrument because, in this way, the created audio project becomes only an accompaniment to playing the keyboard. In that case, it would be the original subject-matter of the Keyboard course where the pupil can also create his or her own accompaniment. The Music and the Computer course should be based on higher creative ambitions than creating a musical accompaniment. The scope of knowledge as it is formulated in the document is more suitable for the completion of the Keyboard course. Consequently, the question arises what is a graduate of the Music and the Computer course expected to master and what his or her key competencies, skills and abilities should be. In an ideal case, the contents of the course and its respective technical equipment can be defined based on the specifications of the graduates of the course. Evidently, when creating the existing curriculum and syllabus of the course, no basic research had been performed on which one could build. At present, we can only establish that, if the Music and the Computer course is to bring benefits for the pupils, it must primarily develop their creative musical activities and their abstract musical thinking. In this course, too, the technical aspect of implementation should be viewed as a tool to achieve the goal (to create musical audio compositions) and not as the main goal of the training. Of

course, technology as a subject of study should be in balance with the study of music theory. Therefore, at this stage of drafting a new curriculum and syllabus for the course, basic research should look at the possibilities of the contents of the course, based on which the key competencies of the pupils could be defined, in more detail.

2. RESEARCH METHODOLOGY

Since our research is based on certain pieces of knowledge which had been researched already in the previous period, the method chosen was that of applied research. We started off from the methodological guides meant for training at a professional level. The reason for such an approach is the development of an extensive research set that could be adjusted to education at primary schools of arts in the next phase by didactic reduction. In the past, several pieces of research dealt with this issue. One of the most significant ones was a quantitative questionnaire survey by Doug Bielmeier in 2014. It mapped the opinions of 100 teachers working at various universities in the US about courses focusing on communication, technology and staffing in the field of training audio technicians. [3] In the next year, the same researcher presented another interesting quantitative questionnaire survey focusing on fresh graduates of audio engineering courses and studied the preferences for skills which were the most important for them to succeed in practice. This research brought interesting findings from the aspect of music education. The graduates ranked the utilization of their knowledge of music theory and aural analysis as the most important and, at the same time, most demanding skills. Some respondents, however, stated that their study programme did not contain music theory at all. [4]

One of the most complex pieces of research on preferences for the skills and abilities of sound technicians is David Tough's quantitative questionnaire survey in 2010. The respondents were 52 professional sound engineers whose task was to mark the key skills and competencies for the work of a sound engineer until 2019. [20] All the above surveys shared a focus on a wide range of skills and competencies from various interdisciplinary fields. The data gained by quantitative methods, however, only mapped the situation in a given period, without any effort to constructively intervene in the development of any curriculum. The ambition of this research is to present a systematization and planning of the integration of the various examined topics into the contents of the Music and the Computer course and to define recommendations regarding the skills and competencies the graduates of the Music and the Computer course should have.

2.1 Research Objectives

When setting the objectives, we drew on previous pieces of research that presented findings generally. Consequently, research in this study deals with the two basic areas of the Music and the Computer course: the audio technical and the musical one. The aim of the research was to characterize the examined publications and find out the frequency of the use of the selected musical and audio technical terms they contain. To achieve the research objectives, we used the method of grounded theory [9].
Based on the outcomes of the research:

- concepts were formed to formulate the contents of the Music and the Computer course,
- the skills, abilities and competencies of the graduates of the course were defined,
- the requirements for the technical equipment required for the instruction were specified.

2.2 The Subject of the Research

Publications chosen based on a deliberate selection according to the following criteria represented the subject of the research:

- the publication is characterized as a textbook or methodological guide,
- the publication was issued by a renowned publisher focusing on education in the audio and multimedia field,
- the author of the publication is an eminent figure in his or her field, with several years of practical experience,
- the text of the publication was available or could be converted into an electronic form (this requirement is directly connected to the research methodology).

Due to the fact that no publication available in Slovak language fulfilled the above criteria, we chose 16 foreign publications, published by six various publishers, into our research set. Publications by the Focal Press (Annex R) are represented in the largest number, since this is the oldest and most prestigious publishing house for methodological literature in the field of multimedia, established in 1938 by Hungarian photographer Andor Kraszna-Krausz. [13] Four publications were published by Thomson Course Technology, established in 1989. It is the first publishing house that publishes methodological guides focusing on modern digital technologies. [1] Oxford Press, MixBooks, Flux Research and KIQ Productions are represented by one publication each. Oxford Press is one of the oldest publishing houses, established in 1478, and publishes methodological guides in several scientific fields. MixBooks issued its first publication in 1981 [14] and specializes exclusively in methodological guides for working with sound and sound technologies. Flux Research was established by Michael Paul Stavrou in 2003 [17] and serves for publishing his original texts and methodological guides. Similarly, KIQ Productions was established in 2000 [15] and is meant for publishing the specialized publications written by David Moulton.

2.3 Carrying Out the Research

The research consisted of three phases and took seven months. The preliminary phase consisted of the study of the existing pieces of research so that the suitable field and subject of research could be selected. The deliberate selection of sixteen publications was followed by the other phases of the research:

Phase 1 (descriptive method and partial evaluation of the qualitative research)
The detailed study of all the publications was the most demanding part timewise and focused on characterizing the texts by the descriptive method. The following parameters dominated in the characterization: the structure of the work and its logical arrangement, and a brief overview of the contents of each chapter with an emphasis on the specificities connected to musical and audio technical terminology. In each case, the characterization included also a brief overview of the professional specialization of the author of the publication, a determination of the difficulty of the text with respect to the age category, the connection of the publication to cultural and social conditions, and the possibility of a didactic reduction of the text for educational purposes at the primary level. This phase represented exclusively the qualitative part of the research by the descriptive method whose purpose was to help compile a logical curriculum and syllabus for the Music and the Computer course.

Phase 2 (conceptual saturation and partial evaluation of the quantitative research)
By conceptual saturation with the help of software analysis, relevant data were collected for the research and 20 most frequently repeated terms from the field of music and 20 from the field of audio technology were manually selected in each publication. The selected terms are unique and their meaning is immutable. Limiting the selection to 20 terms resulted from the requirement that the frequency of the repetition of all the selected terms should be minimum 0.01% of the whole text. In some of the publications, due to the low frequency of the use of the terms, some of the terms were selected even below this level. In this phase, verbal evaluation of the percentual representation of musical and audio technical terms was assigned to the characterization of the publications.

Phase 3 (theoretical sampling method and complex evaluation of the research)
The third, final, phase of the research focused on creating concepts for producing a proposal for the new curriculum and syllabus of the Music and the Computer course. By software analysis, the collected terms underwent several statistical processing operations, divided into the following categories:

- percentual expression of the frequency of the occurrence of the terms,
- marking the terms with a three-digit code based on their affiliation to a certain concept,
- arrangement of the coded terms into concepts that belong either to the musical or to the audio technical terminology
- expression of the percentual representation of the terms and concepts by the relative percentual comparison of their proportion,
- expression of the results by 100% bar charts.

The evaluation of the research is presented in two parts – individual characterization of the publications and evaluation of the concepts as a starting point for designing the contents of the Music and the Computer course. In the first part of the evaluation, the publications are arranged in an alphabetical order. A similar arrangement is maintained even in the tables in the annexes.

2.4 Contentual Concepts as Starting Points for the Formulation of the Contents of the Music and the Computer Course

The theoretical sampling resulted in a saturation of 127 terms. Fifty-seven terms fall under musical terminology and seventy under audio technical terminology. Some terms occurred in the various publications in other, synonymous forms. These are stated in brackets (Annex Q and Annex R). The terms were marked with a code according to their attributes and concepts representing specific fields of study were developed based on the coding. Seven concepts arose in the field of musical terminology.

Expressions with a general character, superior to musicological disciplines, fall under general musical terms (GMT). These are connected to the field of musical culture and name its elements. The concept of music theory (MST) is created from terms used in the theory of the tonal system, metric division and rhythm, and horizontal and vertical relationships (harmony and polyphony). It also includes terms that characterize how tones behave from the acoustic point of view. Organology (ORG) presents a categorization of the names of musical instruments, or even their parts, and also contains the names of instrumental ensembles. The concept of aural analysis (ARA) contains terms connected to the perception of sound and aural skills, or even with terms connected to the hearing apparatus. The concept of musical forms (MSF) consists of all the terms that denote a section or a movement of a musical form, or an entire musical form, and the way of its arrangement. Musical genres (MSG) include terms from the category of classical and popular music. Lastly, the concept of functions of persons (FOP) involves the various roles of individuals who take part in audio productions.
Based on the coding, we arrived at five audio technical concepts. Acoustics (ACS) pools all the terms that name sound and characterize its physical parameters. The concept of electrotechnology (ECT) consists of terms denoting the parts of audio equipment and electroacoustic phenomena. This concept falls partly under acoustics but has no direct connection to the musical sphere and is oriented exclusively technically. All the terms directly connected to digital technologies in music form part of the concept of digital and computer technologies (DCT). These include mainly general terms denoting the tangible (hardware) and intangible (software) elements of digital technology used for working with sound. Terminology denoting the way of working with sound and the names of tools to edit sound (WST) represents an extensive set consisting of the names of the functions and parameters of sound effects, as well as the names of the technical processes of their use. The fifth audio technical concept represents a set of the names of the elements of recording and reproduction technology (RRT), of the so-called sound recording chain.

Charts 1 and 2 show the relative percentual representation of the concepts. For ease of reference, the names of the authors are stated along with the numbers in the description of the charts. The whole list of the titles of the publications can be found in Annex R.

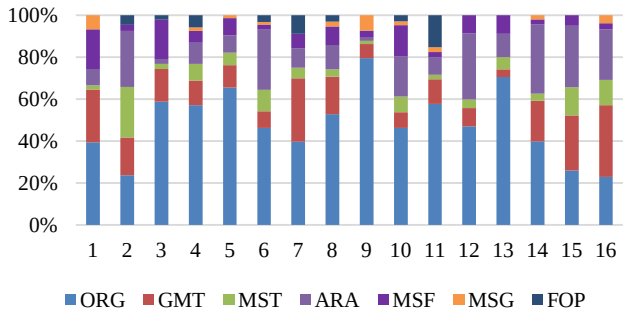

Chart 2 Percentual comparison of the proportions of musical concepts in methodological guides: 1. David Gibson, 2. Douglas Self, 3. Geoffrey Francis, 4. Steve Savage, 5. Roey Izhaki, 6. Michael Stavrou, 7. David Miles Huber, 8. Bruce Bartlett, 9. Bobby Owsinski (Recording...), 10. Bobby Owsinski (Mixing...), 11. Mike Senior (Mixing...), 12. Mike Senior (Recording...), 13. Tim Crich, 14. Garry Gottlieb, 15. Francis Rumsey, 16. David Moulton

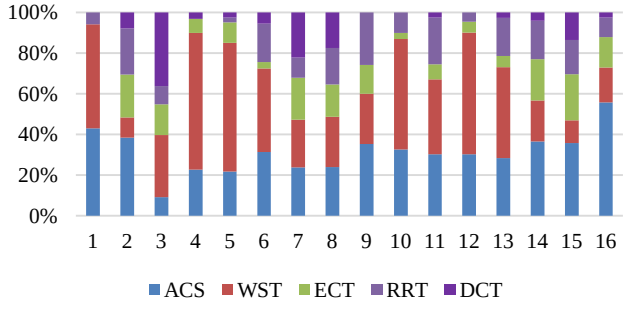

Chart 3 Percentual comparison of the proportions of audio technical concepts in methodological guides: 1. David Gibson, 2. Douglas Self, 3. Geoffrey Francis, 4. Steve Savage, 5. Roey Izhaki, 6. Michael Stavrou, 7. David Miles Huber, 8. Bruce Bartlett, 9. Bobby Owsinski (Recording...), 10. Bobby Owsinski (Mixing...), 11. Mike Senior (Mixing...), 12. Mike Senior (Recording...), 13. Tim Crich, 14. Garry Gottlieb, 15. Francis Rumsey, 16. David Moulton

3. PROPOSAL FOR A NEW CURRICULUM AND SYLLABUS FOR THE MUSIC AND THE COMPUTER COURSE

In all the fields of contemporary education, the trends favour strategies based on experiential learning preferred over a purposeless memorization of facts. In spite of that, the Music and the Computer course has a strong tendency to fall under the group of subjects where memorizing and theoretical learning is still preferred. This is partly due to the contents of the course where pupils have to learn a lot of new and specific pieces of information. Creating a proposal for new contents of the Music and the Computer course, formed by the concepts processed in the previous chapter, became important for this very reason. In the new educational approach, the largest part of the knowledge should be acquired by the pupils through practical activities and experiential learning. [8] In the current setting of the contents of the Music and the Computer course, the dominant part of the training is formed by MIDI technologies, which represent the most abstract form of audio production [5] and are connected with a number of theoretical pieces of knowledge. The contents should be changed substantially first in this respect, and this might even lead to a change in the profiling of the graduates of the course. Therefore, it is not enough to only update the contents but a proposal of a new curriculum and syllabus should be formulated for the course. Teaching should always keep in mind the principle of graduality, from specific to abstract, and MIDI technologies should be reached through actually creating and editing sound recordings.

Besides the dominant position of MIDI technologies in the contents of the course, emphasis is placed on improving the pupils' skills at playing an instrument. At the same time, this area is defined as profiling. However, the course should mainly focus on developing the musical and audio creativity of the pupils, and the concept of improving their skills at playing an instrument is not really related to this purpose. The quality and the originality of the final musical and audio form which the pupils are able to create are not connected directly to their performance skills at playing an instrument. Another change in the graduate profile must be made in balancing the graduates' musical and technical skills. Currently, an orientation on the technical aspect of audio production significantly prevails in the course. This trend can be seen even in the publications studied and, as Chart 3 reveals, technical terms represent over 60% of all the most frequently used terms. Therefore, it is a problem in education on a higher level.

If the subject of study should be audio production, instruction should be artistically oriented. [18] Consequently, the primary goal of the Music and the Computer course should be the acquisition of musical and technical competencies that result in high-quality products by the graduates from the aspect of music as well as that of sound.

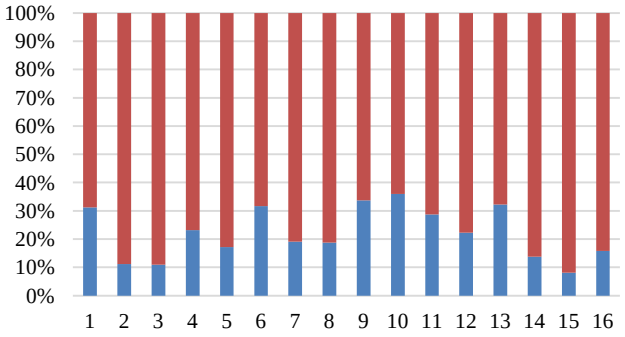

Chart 4 Comparison of the representation of musical (blue) and audio (red) technical terms in the absolute percentual evaluation of the quantity of the most frequently used terms in the methodological guides: 1. David Gibson, 2. Douglas Self, 3. Geoffrey Francis, 4. Steve Savage, 5. Roey Izhaki, 6. Michael Stavrou, 7. David Miles Huber, 8. Bruce Bartlett, 9. Bobby Owsinski (Recording...), 10. Bobby Owsinski (Mixing...), 11. Mike Senior (Mixing...), 12. Mike Senior (Recording...), 13. Tim Crich, 14. Garry Gottlieb, 15. Francis Rumsey, 16. David Moulton

The balance of the contents of a course can only be achieved by the right setting of the structure of its curriculum. In this respect, we can begin with the structure of the examined publications because the contents of the majority of them are arranged in a logical order. Only Gibson's, Stavrou's and Bartlett's publications are an exception, in which the authors treated the text in a completely different way than methodological guides do because they contain several illogically arranged chapters. Nevertheless, we can establish that the majority of the publications starts with general information about acoustics and hearing and progresses gradually, through descriptions of recording technologies, to working with music software and mastering sound recordings.

The publications differ in the quality of the specialized language and the quality level of the information stated. Some publications use a strictly technocratic and extremely difficult language whereas others are written in a more straightforward, simplified and comprehensible way. Based on this qualitative polarization of the examined sample of publications, we may state that methodologically sophisticated education of an institutional character is indispensable for training graduates in any field that specializes on audio production.

For the Music and the Computer course, we have chosen David Moulton's publication, Total Recording Book: The Complete Guide to Audio Production and Engineering, as a starting point to develop the new structure of the syllabus. Its structure falls closest to the desired arrangement of thematic units even in the case of education at the primary level. The currently valid structure of the contents counts with three levels of education according to the primary dispositions of the graduates but the new structure of the course aims at consolidating the contents of the syllabus. In the future, the different standards of the graduates will have to be reflected based on the practical experience of the teachers. Since instruction in the second and the third year takes place individually, the teacher even now has the possibility to adjust the speed of the instruction to the pupil. The new contents of the curriculum, taking into account the respective concepts and didactic reduction, are illustrated in Table 1.

Table 1 Proposal for the new structure of the curriculum of the Music and the Computer course

Proposal for the structure of the curriculum of the Music and the Computer course
1. year 1 (group instruction) ▪ characteristics of sound and its connection to music, ▪ definition of persons participating in audio production, ▪ basics of working with audio devices and computer technologies (practical exercises to create sound recordings by role play), ▪ the relationship of the technical and music-theoretical terminology ▪ development of aural skills by didactic software.
2. year 2 (individual instruction) ▪ advanced work with sound recording devices and ways of recording various musical instruments, ▪ advanced work with recording software and the artistic and aesthetic dimension of sound recordings (editing sound recordings, functions of instruments in editing the sound), ▪ basics of composing music, ▪ creating musical audio projects and developing a sense for musical form ▪ development of aural skills by didactic software.
3. year 3 (individual instruction) ▪ working with virtual musical instruments, ▪ working with MIDI technologies, ▪ orientation in musical genres, ▪ advanced composition techniques, ▪ combining MIDI technologies with real sound recordings, ▪ mastering sound recordings and possibilities of their presentation in the mass media, ▪ development of aural skills by didactic software.

4. COMPETENCIES OF THE GRADUATES OF THE MUSIC AND THE COMPUTER COURSE

The proposal for a new curriculum and syllabus of the course requires a change also in the key competencies of the graduates. Based on the categorization formulated by the National Institute for Education [16] following the management programme compiled by the Organisation for Economic Co-operation and Development [19], key competencies are divided into three groups: interactive use of resources, interaction in heterogeneous groups, autonomous action. In education, several interdisciplinary concepts meet in all the three groups.

4.1 Interactive Use of Resources

With respect to the competencies of the graduates of the Music and the Computer course, we should focus on the first group in which the musical and the audio technical competencies mutually interact. The graduates should be able to use the theoretical bases of the technical and the musical concepts and understand their interconnectedness. At the same time, they should be familiar with a wide range of computer and audio technologies and use them effectively in partial operations of audio production (sound recording, sound editing etc.). Thanks to their intensive aural training, they should be able to assess the quality of the sound recording from a technical aspect and, at the same time, the quality of the musical performance and production. They should be able to musically create shorter units with a focus on popular music and use the technologies as a tool. They should be able to orient themselves in the respective musical genres and have their own musical opinions and taste.

4.2 Interaction in Heterogeneous Groups

Graduates of the Music and the Computer course should be familiar with the roles and functions of the various persons participating in audio production (composer – performer – audio technician). They should be able to act in each role and know the forms of mutual communication and conflict solving. They should be able to work in teams and come up with constructive ideas and solutions. The level of their acquired knowledge from the field of the technical and the musical terminology should enable them to communicate effectively in teams. They should be familiar with the principles of the presentation of copyrighted works in various communities (online social networking sites, concert events, the mass media).

4.3 Autonomous Action

The graduates should be able to orient themselves in the local, national and international cultural developments. They should be able to reflect their own musical taste in their own works and avoid schematism. They should have a natural desire and interest in original and artistically valuable musical audio production. They should have the prerequisites for the improvement of their own qualities by self-learning. As an author, they should be able to work individually and use all the technical and musical knowledge and skills. Also, they should be aware of their limits and do not avoid collaboration and constructive criticism.

4.4 Proposal for the Technical Facilities for the Music and the Computer Course

In the proposal for the requirements for the technical facilities for education in the field of audio production, we must begin with the current requirements for the Music and the Computer course. Currently, its technical facilities are clearly specified in the curriculum and the syllabus. The document for the course was written in 2006 and, therefore, the technical facilities must be updated to reflect the proposed change in the contents of the course as well. Currently, its technical requirements include: a keyboard, a computer, a digital sound card, music software meant for recording in the audio and in the MIDI format, a scorewriter meant for creating scores.

A change in the contents of the course requires adding other technical devices, and we must also pay attention to the suitable adjustment of the classroom from the aspect of its acoustic qualities. Working with sound is a dominant activity of training in the field of audio production, so the instruction must take place in suitable rooms. These must fulfil the basic conditions of soundproofing and, at the same time, spatial acoustics must be adjusted in them to be suitable for sound recording and reproduction. An ideal solution, which is costly though for smaller primary schools of arts, is allocating the training room to a separate building. This would prevent the transmission of the sound to the surrounding classrooms which is a problem currently faced by several schools. If such a placement cannot be achieved, a compromise should be found by adjusting some of the existing classrooms. In both cases, the modifications to the rooms should be solved in collaboration with specialists in the field of acoustics.

There are several reasons why a suitable spatial solution is important. The first reason is the provision of full-fledge reproduction from the aspect of sound for pupils whose hearing becomes their main working tool in audio production. Unsuitable listening conditions create a deformed audio image which ultimately affects the formation of the sound ideal of the individual. One of the most important technical devices, which should be present in a suitably adjusted room, are high-quality loudspeakers. Currently, as a compromise, headphones are used for listening during the course. In the coming years, there is no sign that education in the field of

audio production could do without them and it is unlikely that the conditions in the schools would enable us to create an aurally isolated working room for each pupil. It represents a problem mainly in the case of group instruction. The use of headphones, however, should be limited to a minimum duration due for hearing health reasons, and listening through loudspeakers should also be made possible. Furthermore, updating the technical facilities must take into account the field of creating sound recordings. An important element in recording live sound is the microphone and the schools should have several types and models of them for teaching purposes. From condenser microphones meant for recording singing, speech and acoustic musical instruments up to dynamic microphones that can handle even the strong pressure of electric instruments, such as an electric guitar. If a school has an adequate number of microphones, it can even create sound recordings of the concerts of its graduates or of the class concerts of its pupils on its own. Schools usually pay large amounts for these services. In the initial phase, the number of the microphones can be limited to 8 pieces, depending on the dispositions of the other piece of technical equipment required for creating and playing sound recordings – the sound card. Currently, the norm is to connect maximum eight microphones to a single device and this number is enough for all the situations that pupils deal with during the course. Generally, the presence of sound recording devices is an indispensable element of instruction in the field of audio production because the pupils can learn to work with sound only through these. Editing sound recordings and audio production is carried out by digital devices and, consequently, technical facilities should also include a computer equipped with relevant software. The ideal recommendations of the parameters and the specification of the IT devices should not be defined because development in this field of technologies progresses very rapidly. We can only follow the general recommendations stated below:

- the computer technologies must fulfil the minimum required criteria defined by the manufacturer of the music software,
- the noise level of the computer meant for working with sound must be minimized,
- to ensure the right connection and functionality of the sound card, the computer must be fully compatible with the criteria specified by the manufacturer of the sound card,
- the computer technologies must be horizontally updated within a reasonable period, ideally simultaneously with updating the software and according to the respective recommendations of the manufacturers.

The most important element of the technical equipment is the music software, to which most attention is devoted during the whole training process. The current curriculum and syllabus of the Music and the Computer course recommends buying two types of programs – a digital audio workstation (DAW) and a scorewriter. While a DAW is a key technology for the training, the question remains whether, and to what extent, attention should be paid to creating a score. This knowledge is necessary for the teachers rather than the pupils. Even if the software equipment is limited only to DAW, currently these are also equipped with a scorewriter and the quality of its functions is adequate for gaining basic knowledge in the field of scorewriting. Virtual musical instruments should also be added to DAW, by which the pupils can learn to use even MIDI technologies. With respect to these, a MIDI keyboard is a suitable technical device. The software, which does not currently figure among the recommended technical equipment, is a didactic software meant for improving listening skills. In the case of teaching audio production, however, software specializing primarily in the detection of frequency bands should be present, and the pupils should work with it throughout the course. Also, with respect to computer technologies and software equipment, we must consider their quantity in a way that would enable each student to work on them individually as part of the individual form of learning. The technical facilities required for the teaching depend largely on the specific teacher and, therefore, it is not necessary to clearly specify the devices. It is important to pay attention to the level of the knowledge and the skills of the teachers who want to teach audio production.

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