Sound in Multimedia: The importance of audio production in the design of multimedia educational materials.

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ABSTRACT:

The aim of this paper is to show the importance of sound in the production of educational multimedia materials and packages. The process of and the equipment required for producing audio, with the computer as media manager, are also described, as well as the software programs normally used and the file formats most common to authoring programs.

Descriptors: Music; Sonorisation; Multimedia; Audio

1. INTRODUCTION

Until recently, audio production has been of little importance in the design of multimedia teaching products and packages. As opposed to the old PC sound systems, sophisticated modern systems can take advantage of countless electronic and electrical pieces of equipment, ranging from simple sound cards to sound generators and synthesizers. Moreover, the computer industry for musical creation and production increasingly includes simple interactive resources with its software, resulting in packages that are easier to use and of higher quality.

Another thing to be aware of, when producing audio for multimedia, is that nowadays more and more computers come with the necessary devices for playing digital quality sounds already installed.

In this paper, we therefore intend to reflect on the importance of audio in multimedia, from the design phase to the final production, whether the software is commercial or educational. We shall also show how audio can be the main motivational force for learning, as we believe that audio can develop cognitive abilities, as well as making the learning experience more interactive and attractive. Concomitantly, we shall describe the production process, the most popular software used for musical

composition and creation, and the audio digitalisation, edition and compression process.

2. AUDIO IN MULTIMEDIA.

The development of sound systems for desktop and portable PCs has permitted the incorporation of soundcards, speakers and internal and external peripherals for controlling sound-recording and playback, software for composing, sequencing and editing music, as well as audio and video compression software making it possible for multimedia programs on CD-ROM to approach those on the Net.

Therefore the element where the highest expectations from multimedia packages will lie, whether commercial or educational, will be **audio**. This may appear in a huge variety of forms and with a huge variety of purposes. Audio is no longer an element that is foreign to the production, but rather the factor responsible for breaking the monotony and for making the product more attractive and interactive.

Unquestionably in today's society, known as "the multimedia or the information society", multimedia products that lack an elaborate audio interface will not be acceptable. Multimedia products will have to provide users, as well as graphic interactivity, an elaborate soundtrack, sound effects to enhance graphics, images, text, narrations, voiceovers etc. Consequently, the power of communication and interactivity via the audio interface will bring us an even closer relationship with the computer. In the words of Aguadero:

> "Until now human-computer interaction has used our sense of touch, via the keyboard and mouse. However our normal personal interaction with the world around us is only 1.5% by touch, 83% sight and 11% hearing. Evidently our interaction with computers has to be via our senses, as with all types of contact, and among these is the sense of touch, but until now the narrowest and most complicated way of understanding was chosen, that of only using our sense of touch (1.5% of our sensory range), while the communication and interaction possibilities offered by "first-class highways" such as hearing (11% of our sensory range), or "super highways" for perception such as sight (83%) have been ignored. This indicates that in the future, progress in human-computer interaction should take these two sensory aspects into account. (Aguadero, Francisco.1997: 74)

We should therefore take two elements into consideration when we design multimedia: firstly, the society around us, ever more demanding and critical as technology develops, a society that expects innovation and access to the power

inherent in the media used in multimedia systems. In the words of Jesús Salinas "People have educational, social and emotional needs to communicate. Our response to these needs will be largely responsible for the success of the system we are building". (Salinas, J. 1998: 167).

In the same way, we should secondly take into consideration the characteristics acquired by multimedia from hardware and software developments, allowing digital information to be input, stored and reproduced, whether text, video or sound. By this we mean the visual and sound communication capacity provided to the user by these products.

These products should thus make use not only of computer systems' interactivity, but also of **audiovisual** *(The term is most correctly used in a conjunctive sense, to refer to media or works that are expressed through the interaction of visual images and sounds. Ferrés P., Joan.1998: 116)*. language, until now the province of more traditional media such as TV and films.

There is no doubt that from now on, multimedia product design should come closer to the design of products that use audiovisual language, seeing sound and graphic events as one sole element, rather than as separate elements each with their own language, combining image and sound in order to synthesize the information, and make it more effective, as opposed to computer productions with storage and text-, image- and number-processing limitations.

So sound is unquestionably as important as graphics, and neglecting or failing to plan for this is as unpardonable as neglecting or improvising visual elements.

> "In audiovisual communication, meaning comes from the interaction of the many visual and sound elements. It is the result of interactions between images, music, the spoken text, sound effects etc. Good audiovisual is therefore a language of synthesis. Meaning comes from the right interaction of all the expressive elements in play. A good synthesis, where the expressive elements interact well, are demonstrated by the fact that the receiver has a unified experience". (Ferrés P., Joan.1998:118)

2.1. Audio in design

Some say that the most important thing in the design of multimedia learning materials is the pedagogical aspect, others that it is the graphics or visual aspects, but they quite forget the communication and interactivity via audio, both with the other

product elements and with the user. For Antonio Bartolomé (1999:72), when speaking of educational media design, two underlying designs have to be considered: firstly the communicative design, referring to the planning and preparation of the communication processes, which will decide human-computer interaction; then the learning design, which refers to the strategies to be used in order to achieve the learning objectives. So audio will be part of both designs: in the communication process and in the strategies for achieving the learning goals. In other words, products and media developed for teaching, with the aim of strengthening the teaching-learning process, should place an even higher emphasis on audio production.

So we see that, audio being an essential element for transmitting information and making the most of multimedia systems, as well as generating the need for an audiovisual identity, the time to identify a musical idea for the soundtrack and the interactivity via audio is in the design phase, as this is when all the media that will make up the product and the ways in which they will interact have to be considered.

The search for more effective communication and for an audiovisual identity for the product leads us to the search for a musical idea, which may be accomplished by means of an original soundtrack [1] or by that of a compiled soundtrack [2]. In order to produce a good soundtrack, the production team will have to take into account the relationship between images and sounds, and how the sound can reinforce graphic events and provide interactivity with the user via audio.

The relationship between images and sounds is usually established in three ways: by contrast, when image and sound are used to set up a contrast; by superposition or addition, when the two things offer mutual support to the same idea; and passive, when the sound appears insignificant or unaffected by the image.

2.2 Producer and user

Two more factors should be considered when we refer to the need for audio in multimedia: the first is the producer, who today can make use of countless electronic and electric devices, as well as diverse software available for creating, producing and editing sound events. The producer will certainly make use of the tools and technical and technological possibilities required to produce digital quality audio, thanks to the development of devices that work in conjunction with computers, which make the task easier and cheaper.

The second factor to consider is the users, who are becoming more and more demanding with regards to multimedia products: they buy those that provide them with the simplest routines, the most instructive and intuitive, with the best audiovisual communication. For example, products that offer the option of having the contents narrated will enjoy greater market success, since there are people who cannot or do

not like reading, preferring to listen. We should also consider that most computers today are equipped with sound devices, which can replay the multimedia's sound events with quality.

Therefore, looking at sound events from this perspective, we find that from the design until the production and final edition of the material (independently of its purpose), the product acquires greater value and, at the same time, becomes more attractive and motivating, which may be a decisive factor in its success, *"uma trilha bem escolhida auxilia na retenção de dados e serve de chamariz para o usuário".* (**Ferreira, J.** 1995:21)

3. THE PRODUCTION PROCESS OF AUDIO

The production of audio involves three different phases, the first being the search for an audiovisual identity, as we said above; our product needs a musical idea so that the graphic message can be learnt and reinforced, so the composer or the musical producer needs to know the whole design of the material.

Secondly, there is the knowledge and discovery of the technical possibilities of the media and of the platforms that will be used in the production; the composer or the musical producer will have to choose the platform, the equipment and software that best suit the needs of their production, and then the creator will embark on the process of getting the most out of the musical idea previously decided on. This means that at this stage the creator will question, discuss, investigate, collect, explore, ponder on its strengths and weaknesses, determine the necessary guidelines for achieving success, and surround themselves with the production media to be used to produce and make a success of the idea that they have thought of and decided how best to exploit.

> "Creation requires technique, which may be crude or refined, depending on the nature of the media". (Kneller. George F., 1973:66).

Having access to and knowledge of the best possibilities for producing a certain element will therefore be essential in order to achieve the best results.

The third phase consists of producing the sound events effectively, which may be done in two different ways or as a combination of the two: the first, by using musical compositions produced electronically (with keyboards, synthesizers or on the computer itself, using music and sound creation and edition software); the second way can be achieved by digitalising commercial music recorded on CDA, CDL, LPs, tapes etc...

For the first, the person will need a background in music, especially in musical structuring and orchestration, as well as skills in working with music on the computer. They will need to be familiar with the hardware, software and electric and electronic peripherals for the best production of sound files. We will comment on two basic factors for the production of sound files applied to multimedia, first the MIDI system and then the software used for creating, editing and producing audio.

3.1 The soundtrack

When thinking about working on producing music with the computer, we will unquestionably be talking about the MIDI system, as this has become not only the communication between instruments, but also a way of thinking, learning, creating and producing music. The MIDI system appeared because of the need to combine various electronic musical instruments into one sound source, when, around 1980, many brands were fighting for the electronic musical instrument market, each using their own sound models and classifications.

In other words, each machine, depending on its make, had its own instrumental classification, which was very discouraging for musicians in computing, who, to manage to use two or more instruments in conjunction, almost had to be experts in the technology or had to have equipment of the same make.

It was only in 1983, when the manufacturers came to an agreement and created the MIDI Interface *(Musical Instruments Digital Interface)*, for electronic instruments, that things started to improve. The Interface provided a physical communication standard between systems (connectors, cables, communication protocols) and the language's characteristics made it possible to exchange information between systems. Nonetheless, things improved definitively for computer musicians when the manufacturers developed the General MIDI Standard, which would establish certain configurations for all instruments calling themselves GM compatible.

 The most important configurations established by the GM standard were the number of voices and the quantity of sounds that can be reproduced, all linked to a program number (Program Change).

With the aim of making the sounds available in an ordered way, they were organised into 16 groups, each of these having eight variations, and it also provided a percussion set that can always be found on the MIDI10 channel.

It is still however important to remember that MIDI does not transmit sounds, but information on how a certain musical piece should be reproduced, so the quality of

playback of this information is dependent on the quality of the reproducing sound device of each computer, whether this be internal or external.

A basic **MIDI system** is therefore one that allows us to create sequences and play them back on keyboards, synthesizers, modules and/or sound cards. In order for them to work, we need a computer with software that we can use to edit or sequence interleaved sound with sound devices, which may be internal or external to the PC.

3.2 Files in MIDI format

Thanks to advances in the software designed for musical creation and production, files can be produced today in MIDI format with *Sequencer Programs*[1] and with *Score Editing Programs.*

Sequencer Programs are used mainly for recording, editing and playing musical sequences of MIDI events. They are designed for sending and receiving messages electronically to/from one or more MIDI devices. They also allow the addition and correction of notes without the user needing to use a keyboard, as well as tempo changes, instrument setting, track changing etc. They work analogically with a text processor.

Score Editing Programs, which are becoming more diverse and improved every year, are for writing music and use the conventional language. Scores can be produced with them and then printed out on paper, with a high level of quality, benefiting from graphic edition features. They also use media by manipulating music in MIDI format, allowing you to hear what you are writing, generating an immediate aural evaluation.

We will run through **Encore** as an example, as of all the musical software on the market I consider it the best, since it is frequently updated and, most importantly, never loses its simplicity of operation, being quite intuitive, with the main functions being represented by icons. We describe its main functions below.

When we start using the program, the first thing we define is the number of instruments or keys that we intend to use, taking into account that each score has 12 staves and each staves has up to 8 voices. Then we define the type of measure, and the key signature of the piece. You can also decide the type of clefs to be used in including that of the percussion. The user can create changes of clefs, measures and key signature in any point of the staves.

When we enter the notes with a MIDI device, the program, shows the heads of the notes immediately, in real-time. Version four, Passport, includes a virtual keyboard that transforms the computer keyboard into a musical keyboard, with the keys playing

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[1] Webpage. J.Carlos Orós. Tarragona 1996

musical notes, as well as chords, making it very easy to enter notes. The virtual keyboard will also work with the mouse. When MIDI recording, the notes played can be **cuantize** and timing mistakes can be corrected.

It is also possible to work step by step with the help of the mouse or the computer keyboard to put notes into the staves, the user only has to choose the figure that represents a certain duration from the palette and then press the figure with the mouse in the desired position in the staves. The chord figures and the respective symbols used for the guitar can also be included in the score. The user defines the type of chord, for example the bass (Dm/F #), and the program inserts the name of the chord and the corresponding figure. Texts can also be added, such as the words of a song, for example, linked to the corresponding musical notes.

Most of the symbols used for the musical dynamics can be inserted in the score at the time of editing, but when playing this can only be done when they are recorded via a MIDI instrument. The signs for crescendo, the octave (up/down), another volume change (p, pp, el mp, mf, and ff), markings for repetitions and ends can also all be included.

So **Encore**[3] has enjoyed quite a success in the musical world, as its interface offers high-capacity while still being user-friendly. It is a powerful tool for musical creation and edition, as well as being software that is easy to work with. It provides the user with real-time MIDI data-manipulation resources and tools for graphic editing, as well as fulfilling the expectations and requirements of users such as composers and copiers, allowing them to carry out all the tasks and special needs associated with the process of musical creation, production and edition.

3.3 Producing files in Wave format

The production of a wave file is far simpler than producing MIDI files and can be done on any computer, though of course the platform we have used will determine the quality. This will be dependent on the audio edition software we use, the electric and electronic peripherals available and the quality of the CDA unit.

Most soundcards come with an audio editor as controller software, which can be used to produce files in wave format, though this is still somewhat limited. Basically they can record, play and provide limited sound editing capacities, such as for example Sound Blaster cards, which come with Wave Studio software. When better editing facilities are required, we have to fall back on other programs that provide us with more resources (via their tools), such as noise elimination, applying effects etc.

However, from 1987, Fraunhofer JIS, a respected European Research Institute, in collaboration with other research institutions, began to study new forms of compressing audio files, known as the Percentual Coding of Audio, the technique of

eliminating from files what the human ear cannot hear. This led to the birth of a powerful data compression algorithm, which was called "**ISO– MPEG4 Audio Layer–3**", better known as MP3, which allows a file to be reduced to 12 times the original size.

MP3 is therefore a type of file, based on the **MPEG** standard, which allows music to be played on a PC, while using a minimum of space on the hard drive. The 30 MB of a song in WAV format, when converted to MP3 format, would become a maximum of about 3 MB. When we think that what we need online are sound effects for openings and transitions, narrations about page resources and information, the size of the files will be even smaller, allowing us to make our pages more motivating and attractive.

In order to produce files in MP3 format, such as wave files, you just need an audio compression program and a little patience. The process has two steps: first the digitalisation of the audio, and then its compression to MP3. The digitalisation may be direct, by connecting an audio source to the soundcard, using the WAV frequency 44,1 MHz with 16 bit sampling, or by using a «CD ripper». «Rippers» are programs, such as WinDAC32 or Audio Catalyst, that convert a conventional CD to WAV directly from the CD–ROM drive, saving a file to the hard disk for each song.

3.4 Recording Narration and Voiceover events.

The production of voiceovers and narration for multimedia involves the same process as that of wave files. It can also be done in two ways: the first is to produce all the narration in the studio and then digitalise it, the second is to work with the narration directly in the computer, via electronic devices that wofk via MIDI connectors, as mentioned above, or via the USB connection, which transforms the computer into an audio production studio. Today, more than ever before, you do not need to go to a big studio for this sort of production, it is really enough to have voiceover professionals and to be equipped for this type of production.

3. CONCLUSION

When thinking of producing multimedia, you should consider such aspects as: the society you live in, which is in a state of constant change and has an uncountable array of electric and electronic equipment at its disposal, and which expects the products it buys to be increasingly interactive and instructive. Our users also demand that we use all the potential of the medium, and that multimedia design should be more complete. In other words, all of the product's media should be considered, leading to audiovisual coherence.

It follows that audio production has to take into account (from the design phase to the final production of the material) that sound cannot just be added in, it has to be thought of in conjunction with the graphic elements. When the product is evaluated, this should include its esthetic look, not just its technical aspects. Always bear in mind

that the quality and the type of audio will be responsible for the final product's interactivity and attractiveness.

ANNOTATIONS

[1] Unedited musical composition, written exclusively for an application, which may be instrumental, vocal or a combination of both, which may also use electronic and/or accoustic instrumentation. Today there is a visible trend in soundtrack production for films, where musical producers aim to develop a unique musical theme for the product and then take from this all the sound events that appear in the the film, thus intensifying even more the audiovisual identity of the product.

[2] Track comprised of existing musical pieces, adapted to the needs of the musical producer.

[3] **Ratton**, Miguel, Informus: 1998, www.music–center.com.br

[4] MPEG <http://drogo.cselt.it/mpeg/) The term is an acronym of "Moving Picture Experts Group, a workgroup of SO/LEO, an International Organisation that sets technological patterns. The aim of MPEG is to develop decompression, processing and programming patterns for video, audio and combinations of the two.

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