

# Game Sound Education at the Interaction Design Department of the Zurich University of the Arts - Between Research Laboratory and Experimental Education

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**Abstract.** Game design education is still a rather rare subject at educational institutions, even less common is the topic of game sound design. At the Interaction Design department of the Zurich University of the Arts (ZHdK), Switzerland, we have introduced several interconnected courses that teach aspects related to game sound design, taking into account the special requirements at a school for art and design. In order to deal with the lack of best practices and examples that could help us orientate and define such a program we develop the courses along research questions, investigating at the same time the theoretical foundations by using the courses in game sound design as experimental laboratories. This iterative cycle of teaching and analysis helps us to advance both education and research.

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## 1 Introduction

Since the arrival of the AdLib Music Synthesizer Card (1987) and the Creative Labs Sound Blaster 1.0 (1989) game audio has played an increasingly important role in the market. Therefore, when the game design curriculum was introduced at the Interaction Design department (IAD) of the Zurich University of the Arts (ZHdK)<sup>1</sup> in 2003 it was soon clear that also sound design should play an important role in the curriculum. When game sound was finally introduced in 2005 the question was: What should such a program contain, what are its elements and how should they be structured?

In this paper I describe our approach of integrating game sound education and research in a loop that facilitates mutual fertilization and makes it possible to advance both aspects. In the first section I will outline the current situation of game audio education. Then I will introduce the main research questions that are relevant to students of game audio design at an university of the arts. In the last section I will describe the curriculum at ZHdK and show the mutual links between education and research<sup>2</sup>.

## 2 The State of the Art in Game Audio Education and Research

The most obvious first step to find out how to develop a curriculum was to look at existing educational opportunities. In fact, courses in entertainment technology or game design are offered at many universities (see, for example, [31]). However, while there are countless courses on graphic design, 3D modeling, or even programming available, sound related courses, let alone game sound related ones, are still relatively rare. In the private sector things do not look much different, even at well-known institutions such as the Games Academy [1], finding something about sound design in the curricula is difficult. The SAE institute [30], probably the most renowned international school for audio engineering, offers game design related degrees in collaboration with the Qantm college [12], but apart from digital audio, editing and mixing courses also here nothing can be found that is specifically

related to game sound design. The same is true for the International Game Developer Association's Special Interest Group on Game Education [2].

A potentially helpful source, the Game Audio Education Working Group of the Interactive Audio Special Interest Group (IASIG), describes its mission and aims as follows:

"Game audio requires a myriad of specialized audio skills. Currently few web sites and books provide resources to educate new people who want to get involved in game audio. This project sets out to offer an additional resource for people to use in learning about game audio. Its overall goals include:

- Shortening the learning curve of new audio personnel in game audio by providing resources that people can learn from.
- Creating a clear reference for terminology and creation methods in the world of game audio.
- Supplying schools with information to integrate game audio education into their curricula." [22]

In fact the IASIG Wiki [23] offers an extensive list of relevant aspects to be covered in game audio education. Unfortunately, as the working group has been closed, there is not too much activity on the Wiki and many questions, especially around designing for interactive media and games, remain unanswered.

### 2.1 Game Audio for Art and Design

There is no doubt, getting to know and master the tools of the trade has to be covered in a curriculum on game audio design. However, especially at an university of the arts, essential skills for students to acquire are to be able to develop original aesthetic designs and the ability to express oneself artistically. While this requires a lot of experience that cannot be taught directly, there are some areas of knowledge that form an essential basis to acquiring those competences: Understanding the importance of communication, semiotics and aesthetics while providing the functionality required for usability and game-play.

In order to find more information about what should be part of a game audio curriculum satisfying these requirements we also looked at publications. There are some excellent books on game audio, however they focus on the practical aspects of design and

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<sup>1</sup><http://iad.zhdk.ch>

<sup>2</sup>Please note that the emphasis of this work lies on a general notion of sound and not specifically on music or voice, although it may include it as well.

implementation and do not really deal with semiotics or functional aesthetics. Some works focus more on sound design and business [29], others on aspects of programming [38], [6] or the development process as a whole [7]. Theoretical frameworks for film sound design, such as those developed by Chion [9] or Flückiger [17], may help to develop theories for game sound, but they usually are not sufficient to understand game sound phenomena completely.

Since a few years this situation is slowly changing, though, as more and more online and offline sources explicitly related to this topic appear. Interesting online resources are for example the game sound design section of filmsound.org [8], the audio track on Gamasutra [20] or the website of the Game Audio Network Guild [24]. Collins runs a website that provides a rich source on game audio, among others a glossary and a description of functions of game audio [13]. There is also an increasing number of scientific offline publications which are of interest. Ekman has published an interesting paper introducing a theory of diegesis adapted for computer games [16]. Friberg and Gårdenfors developed approaches to developing a categorization for game sound and include in their work aspects of works from Chion [19]. Moreover there is an upcoming article by Collins, which specifically deals with participatory and non-linear aspects of video games audio [14]. But many of these sources seem to focus on music rather than on sound in general. There is obviously a need for more systematic research on semiotics and functional aesthetics of game sound. My goal is, to contribute to this research on game audio by integrating it into game education. For this, first the core questions of research have to be clarified.

### 3 Topics of Game Sound Research at ZHdK

As mentioned, semiotics, functional aesthetics and individual expression are the main topics for art and design related game sound education. In this section I want to describe more in detail what I mean by this.

The first requirement, which separates games from other interactive applications is *immersion* and support of *flow* [15]. And here sound plays an important role, because it is omnidirectional, multidimensional and encompassing. Moreover the ears cannot be closed [37, 27]. However, achieving immersion requires more than good headphones or a surround sound setup; Shedroff, for example, reminds us that a good story, well told, can often immerse us deeper than a technically sophisticated audiovisual environment [34]. Some important requirements for immersiveness are adaptivity, completeness and continuity in the sound design [25]. But many questions as to what facilitates immersive experiences remains unanswered. This is why I consider immersion being an issue of design and art rather than technology.

We all know the role of sound in giving abstract or fictional objects a "physical" existence, helping to suspend the disbelief in the artificial world. But the functional-aesthetic role of sound goes beyond that: It actually reveals to us the "inner nature" of things and processes, it "*characterizes*" them, a property which is used extensively in computer games. Therefore, the objects we interact with in a game are not just "there", they also reveal their character and meaning in the context of a specific situation in the game. They acquire meaning beyond their simple "existence".

This leads us to the next aspect of game sound design that I consider relevant for our courses: The relationship between *sound and action*. The meaning revealed through sound I just wrote about is revealed through interaction with the game world. And this is one of the essential differences to film sound: We do not passively

watch and listen to a virtual world, we experience it through action.

An example of how sound modifies the meaning and perception of action is how sound connects processes. In film, sound plays an important role in providing continuity between cuts, it can make processes seem continuous even if they are montaged. In games there are no cuts in the same way as in movies. Instead, we may encounter situations like the following: In "XIII" (Ubisoft 2003) a first aid shelf is opened by clicking on it with the mouse and when we approach it further we take out a first aid box. But what actually happens upon the mouse click is this: First there is the door opening itself with a "squeek", our avatar still holds the gun in his hand and doesn't move. Second, the first aid box just disappears, however, we hear a metallic sound of a box put in place somewhere. What we have here are two things: First, the substitution of missing graphical information through sound, and second, the sonic completion of abstract user actions, like mouse button presses, into complex virtual actions.

The action related functions of sound have again an importance on an archaic, psychological level: They satisfy our desire for the manifestation of our action and influence in the world through sound, a concept that Chion calls "*ergo audition*" [11]. I consider this a very important factor in creating overall enjoyable game experiences. Of special interest is a related effect that I call "*differential of power*": If I as a player trigger a loud, powerful sound with a small movement, it gives me the feeling of power and influence, a weak and fragile sound however is perceived as a sign of weakness and powerlessness [26].

Last but not least, there is the concept of "*systemic composition*" of both the virtual sonic objects and the virtual soundscape in a game, which introduces a musical perspective into game sound design. This means that we can study the sounds of a game as a kind of ensemble composed of a multitude of sound emitters, which are differently configured and placed, and the player's movement through the environment and her interaction with objects in it generates a dynamic sonic arrangement and mix. This means one has to design a functional-aesthetic system of sounds in time and space rather than what designing a mix means in linear media like film.

To summarize: Meaning in games is constructed in the triad of (inter)action, vision and audition<sup>3</sup> in a nonlinear, modular system of objects and events, with a strong mutual influence between those elements, very much comparable to the audiovisual contract that has been described for film [9]. Therefore, systemic sound design, the relationship with action and the meaning creation processes are the core questions for both research and education at the game audio program of the Interaction Design department at ZHdK.

### 4 Using Education for Research

I have laid out the main areas of interest in game sound research and education at IAD/ZHdK. But how to go about actually researching and teaching these topics? How can research and education be linked in a fruitful way? And: Why should they actually be linked?

As mentioned before, we aim at connecting education and research in a tight loop because there is not enough substantial and structured knowledge to form the curriculum that is supposed to treat questions of semiotics and functional aesthetics. Therefore

<sup>3</sup>Also haptics and possibly other sensorial channels could be included, but sound and vision are certainly the most relevant senses in games today.

we develop the theoretical foundations by using the courses as experimental laboratories, using an iterative cycle of teaching and research. A big advantage of this approach is also the momentum that can be achieved by mobilizing students. In fact, the students often introduce surprising and fresh approaches to analytical and theoretical questions that can help to reorient the research. From this point of view it is actually an advantage that there is not an established "must have" curriculum for game sound design yet.

The courses are project oriented, often several courses like sound design, 3D modeling and programming are joined in a common project. Like this many valuable and well documented cases for further study can be generated in a relatively short time<sup>4</sup>.

In parallel to the courses a *Toolbox for Game Sound Analysis* has been developed and is modified in an iterative way, using the insights gained from practical course and project work. This "living document" serves as a central point of reference and documentation of the actual situation in the process of developing the theory for game sound. Providing the toolbox for the students helps to overcome the fundamental difficulty of understanding and speaking about sounds and sonic experiences in our visually dominated society.

In the following section we will present the elements of this curriculum, how they feed into each other and into research, and how they help to refine the theoretical and didactical foundations on which game sound education can build.

## 5 Course Descriptions and Cases

### 5.1 The Basis for Everything: Acoustic Display

In this first course module the foundations for all subsequent courses are laid. The four-day course for students in the second semester is carried out together with the students of the Interaction Design program, as the content is relevant to both game and interaction designers.

#### 5.1.1 Course Description

The topics are the following:

*Phenomenology of sound and hearing:* First of all, even before acoustics, comes the question of how we experience sound in our everyday "Lebenswelt" (to borrow a term coined by Husserl). Investigating the different modes of hearing and their influence on how sounds are perceived and valued is another important topic that is often underestimated or forgotten.

*Speaking about sound:* This is the first element in a kind of "conceptual sound toolbox". It focuses on basics of sound creation and propagation on a very high level, introducing terms like pitch, volume, timbre, envelope, and the influence of space and material on sound. Building on these elements the concept of everyday listening and sound events by Gaver [21] is introduced. This is combined with the concepts of "objet sonore" developed by Schaeffer [32] (see also [10]) and "sonic effect" [3].

*Notation of sounds and sound events:* An approach to notation of everyday sounds is introduced. This is derived from Schafer's work on soundscape analysis [33] which is a simplification of Schaeffer's taxonomy.

*Soundscape analysis:* Starting from Schafer's work the notion of the soundscape as a sonic system, composed by interacting sounding objects, is discussed. In order to approach sound also from a communication oriented point of view the aspects of acoustic communication and acoustic community are introduced [33, 35].

<sup>4</sup>See also the website of the game design program of IAD: <http://www.gametheory.ch>

*Basic action-sound relationship:* This topic is about understanding the action-sound relationships in the physical world, how our perception and interpretation of objects and processes are influenced by sound and how these fundamental experiences shape our understanding of the world.

*First and second order semantics:* The next step is to look at the many ways that meaning is created through sound, starting with film analysis. Important sources of knowledge are here [36] and [17]. This framework also includes aspects of material, setting, scenography and subjectivization.

*Sound in the context of interaction:* Finally, the fields of acoustic display and sonification are introduced, ranging from basic functions of acoustic display like alarms, status information etc. to the concept of sonification, acoustic icons and earcons.

All of these topics are deepened and discussed in class assignments such as protocolled sound walks or action - sound analysis for everyday objects. The course's final project is the design of an acoustic display for an interactive application. The outcome can be something like functional prototypes for drag & drop sonifications or sonically enhanced objects of everyday use. An example of this course module is documented in [18].

#### 5.1.2 Relevance to Research Questions

Several links between education and research can be identified here:

*Speaking about sound* is connected to the important question of how everyday sounds can be described and categorized. All areas of research and education can build on such systems of description. The exercises allow to test the vocabulary and notation strategies under practical conditions (e.g. when recording sounds and communicating about them with the team for design decision making) and help to improve them iteratively.

*Semiotics and aesthetics:* As mentioned before, understanding film sound is a good starting point due to the extensive theoretical material available. This way specific aspects of game sound design can be analyzed in comparative studies, adapting the methods from film sound study.

The investigation of *action-sound relationships* and the *soundscape as a sonic system* is fundamental to understand the nature of sound design for interactive media.

## 5.2 Game Sound Analysis

This course (about 3 days in total, for students of the second semester) is the first in the program that addresses game sound specifically. It builds upon the foundations mentioned above.

#### 5.2.1 Course Description

After a warm-up listening exercise a theoretical and methodological introduction is given, providing a *Toolbox for Game Sound Analysis*. This toolbox contains, among other elements:

- *General description of the sounds:* what sounds can be heard, what categories (language, music, SFX; subcategories like NPCs, buttons, etc.; categories of everyday listening or sonic objects, (see 5.1.1)) can be identified, what moves and where, description of spatial properties and description of the "sound objects" encountered, etc.;
- *Semantic categories,* such as archetypes, symbols, key-sounds, stereotypes, leitmotifs, etc.;
- *Functional aspects:*
  - *Related to interaction:* general communication (direct, indirect and environmental communication [5]),

disambiguation, focus of attention, meaning for actions, substitution for haptics, etc.

- *Related to narration and dramaturgy*: emotional cues, influence on perception of time, character development, etc.
- *Related to space*: navigation, setting, scenography, construction of the virtual soundscape (sonic landmarks, keynote sound, acoustic definition, see [33])
- *”Musical” analysis*: What is the ”style” and aesthetics of the game? How do the sounds ”work” together aesthetically? How can the ”systemic mixing” be judged?
- Also contained in the toolbox is the notational system developed by Schafer mentioned at 5.1.1.

All analyses in the course are done with the help of this toolbox, which ensures the comparability of the results.

*Analysis of 2D Arcade Games from the 80s*: In this exercise, the sounds of classic arcade games from the 80s (especially from the Atari2600 video game console) are analysed. The analysis of the (technically) rather simple sounds used in those games has several benefits:

- Many basic principles of functional aesthetics of game sound are already contained in the design;
- The limited amount of sounds makes it easier to illustrate those principles;
- Many ”standard” sounds still used today have their origin in games from that time, such as jumping sounds or error sounds;
- Last but not least, the careful analysis of the sounds makes it possible to discover their actual richness and variety and shows that aspects of aesthetics and emotional design have always played an important role in game sound design.

*Analysis of 3D Games*: For this exercise the analysis toolbox is extended by questions related to spatial situation and setting of the sonic events, again based on the notational method described by Schafer (see 5.1.1). This includes questions about where the sound source is located, if and how it moves, how the geographical environment shapes the sound and its propagation, and what other sources are audible in the virtual soundscape.

Also the notion of the acoustic community is investigated in more depth. What does the player hear? What do non player characters (NPCs) ”hear”? Especially since more advanced listener models for NPCs have been introduced, such aspects have gained importance for game design.

*Comparative Analysis*: In the last part of the course the students engage in a more complex project. The goal is to conduct a comparative analysis of two games, using the theoretical and methodological tools provided. Examples of possible comparisons are:

- A ”historical analysis”, comparing a 2D arcade game from the 80s with a modern 3D title of the same genre;
- A comparison of a category of functional sounds (e.g. hit-or pick-up sounds) between games of different genres;
- The analysis of the transformation between a 2D game and its three-dimensional counterpart, e.g.. *Zelda: A Link to the Past* (Nintendo 1991) and *Zelda: Twilight Princess* (Nintendo 2006)<sup>5</sup>.

<sup>5</sup>That such 2D-3D analyses have a relevance beyond purely academic

## 5.2.2 Relevance to Research Questions

Also here, the first aspect is that the terminology and theoretical concepts can be evaluated through practical application, further developing them towards a specific theory of game sound. Also action-sound relationships specific to games can be investigated and differences between genres can be classified. The notation of sounds, originally created for soundscape studies conducted in physical space, can be tested also in virtual soundscapes. The understanding of the mechanisms of virtual soundscapes can be improved (e.g. aspects of orientation and navigation compared to general ”atmospheric backdrop”). For example, a group of students analyzed the soundscape composition of the role-playing (RPG) game *Gothic II* (JoWood 2002) and described, how the soundscape was supporting mainly orientation and navigation while sonifying battles as rather dull events, underlining the character of ”serious work” that battles in RPGs have.

Especially the comparative analyses can serve as input for specific research issues. An example of how the results of such analyses can potentially be used for research is a comparison conducted by a group of students: They compared the sounds of the multiplayer shooter *Quake Arena* (Activision 1999) with the single-player shooter *Serious Sam* (Gathering of Developers 2001). The sounds of *Quake* were very simply structured and had a signal-like quality, while the sounds of *Serious Sam* were very complex, multi-layered constructions with a lot of variety and effects. From this it can be hypothesized that the sound design for a multiplayer game which is used in e-sports requires an approach directed at optimal recognizability and ”legibility” of the sounds and the emotional and narrative component is rather secondary, while in a game like *Serious Sam* each weapon has a complex ”personality” and the general aim is to overwhelm the player in an audiovisual feast.

## 5.3 Game Sound Design

### 5.3.1 Course Description

This course lasts about four days and is aimed at students of the 4th semester. The first exercise is to design a small audio play of about one minute duration. Designing an audio play is an excellent exercise for the essential skill of combining and layering sounds in order to create richer meaning. It forces the students to first imagine precisely how e.g. a machine is constructed or what clothes a person wears, in order to design the sounds that evoke a visual image in the listener’s head. Furthermore the power of added metaphoric or symbolic sonic cues to the sounds can be investigated.

The game sound toolbox is supplemented by a vocabulary for describing SFX, derived from Beauchamp [4]. This vocabulary contains terms like ”whooshes” that are not based on a clear categorization but rather on everyday practice of sound designers.

*Constructing Modular Soundscapes*: In this assignment the acoustic community and the system of sounding objects introduced in game sound analysis serves as a conceptual background to understanding the possibilities and potentials of today’s 3D sound engines, which allow to create not only two dimensional (stereo with fixed channels) soundscapes but actual sound emitter systems that simulate ”real” sounding objects in a spatial environment, with the so-called listener object moving between them (see, for example, [28]). The theoretical and conceptual background described above enables the students to think about the

questions is clearly shown by the advent of recent titles such as *Crush* (Sega 2007) or *Super Paper Mario* (Nintendo 2007) which seamlessly switch between ”classic” 2D views and 3D presentation.

technological possibilities in more challenging ways and use it not only to simulate the sonic "reality" but to transform it and reconstruct it, creating new functional-aesthetic sonic experiences. An example is given below in section 5.4.

*Designing Gameplay with Sound:* Finally, the students integrate the acquired design skills in a project of their own. Usually, the students use the Torque game engine (GarageGames) or the Unreal editor (Epic) to create 3D games in the context of a specific aesthetic framework or genre. For example, last year's assignment was inspired by the movie *Alphaville* (Godard 1965). In addition, aspects of design process management are discussed and methods like rapid prototyping or tools like the development process map [7] applied.

### 5.3.2 Relevance to Research Questions

The design process is conducted along the steps described in game sound analysis and serves to test the analytical framework against a real-life design situation. Here it soon becomes clear, if the conceptual background actually helps to improve design results in any way and if it is useful to formulate and verify design related hypotheses. Moreover, in a design process also new questions for research arise. The introduction of the sound categorization vocabulary commonly used in the industry (e.g. for "SFX" libraries) allows to critically compare it with the more structured approaches mentioned above (see 5.1.1).

### 5.4 Experimental Game Design

This last course in the curriculum aims at integrating all components from the previous courses into one big framework. Here the wealth of the theoretical and practical expertise acquired by the students in the prior courses is brought to bear in order to create original and expressive experiences. Usually the projects are developed by combining courses from sound design, 3D design, storytelling and programming. The goal is to cross borders of genres and media and to design for extraordinary contexts, involving for examples aspects of physical space. Often real clients are involved. The best works are usually presented to a larger public and in the annual diploma show, which serves also as a showcase for the whole design department.

An example project is "Inside/Outside", which was carried out in fall 2006. The aim of this project was to analyze and deconstruct the real space of the ZHdK buildings and reconstruct them in a game. The special treat was that the presentation was done in the auditorium which disposes of a 360° video-beam setup and a 7.1 surround installation. The project played with the real space of this auditorium, the whole school, and virtual de- and reconstructed versions of it. Sound was used extensively in this project, e.g. to transport the identities of places or transgress physical spaces. The results were presented in the auditorium to the public (See figures 1 and 2).



Figure 1: Final presentation of inside/outside to the public.

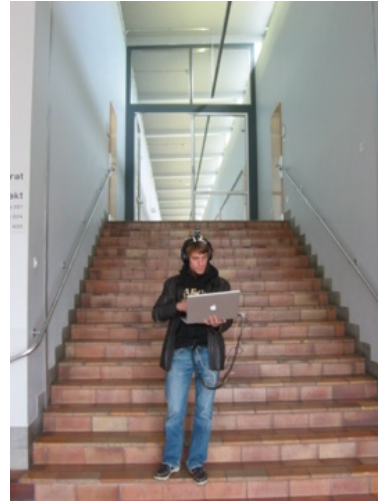


Figure 2: One of the projects of inside/outside used mobile video-conferencing to create a game combining virtual and real space

## 6 Conclusion

In this paper I have described how game sound design is handled in both education and research at the Interaction Design department of the Zurich University of the Arts. There are only few examples that could help to orient the creation of a curriculum for game sound design that suits the requirements of a education in art and design. Also the theoretical foundations are rather thin, albeit growing slowly. I intend to contribute to the research in this domain by linking education and research in our courses in such a way that they mutually enrich and enable each other.

I have described the courses and listed the main topics discussed in them, describing how they relate to research questions. The research questions are focusing on semiotics and functional aesthetics, because I consider these being of special relevance for students in art and design. As the program is still rather young there are not yet many final results or documented impacts on game sound theory but I'm convinced that this will change as the courses iterate.

Doing research in the field of game audio shares some of the challenges also facing design research in general. The question at the core is: how can design research produce scientifically relevant findings? In the approach described here I use theoretical concepts and structured methods in everyday design tasks with students. By documenting results and adapting the "Toolbox for Game Sound Analysis" I can create a experimental laboratory of empiric study within an educational context which, as I believe, will lead to scientifically relevant results very soon.

Very often game audio is considered to be an add-on which will be taken care of by a musician or sound designer. The gifted sound wizard, the inspired musician are somehow mystical figures that contribute something to game design that everybody considers an important part of the experience, but nobody really understands. In my opinion it is important to demystify the role of the game sound designer and open this field to all game design students. Ultimately it will greatly improve the design process and in the end the quality of an overall game design if everybody - also the programmer, the 3D artist or the project manager - know and understand the role sound plays in games.

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