Sound in New Media and Design Studies

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Introduction

The effect of new media on the computerization of cultural practices has moved to a new level and has become more open, common, and prevailing as we deal with new forms of artistic creation and design processes in supporting higher education. Massive changes have occurred in the way frameworks for new media studies have been constructed, and they have had a significant effect on higher education in which sound studies are taught. In the past, sound has not received much attention in new media research and studies. Instead, the emphasis has been on visual processing and representations.

Today, imagining an auditory paradigm that targets new modes of reflection in sound domain activities—activities that result in new forms of interactions in cultural, aesthetic, urban, and media contexts—is easy. Computational tools and new media play an increasing role in this process because they have become ubiquitous in people's use of computers and new technologies to express thoughts and ideas.[1] From an auditory media perspective, digitization of sound has engendered various opportunities in the production and distribution of art and design work. This new form in auditory media has resulted in a growing scholarly interest in interdisciplinary research and studies, just as it brings up further discussions about why sound should be considered a part of design practice and studies.

Not just in terms of sound as a design practice, but design practices in general have begun to address demands for products, services, art, and entertainment—designed as part of everyday culture—that has emotive, functional, intriguing, and beautiful qualities.[2] Sound as a design and mediating element can manifest the qualities of the design object and open up new ways for us to consider our interactions with it. With increased knowledge and understanding of sound as a design element in design studies, students become better equipped to enrich the usability, attractiveness, and communicative qualities of designed artifacts.

1 Lev Manovich, *The Language of the New Media* (Cambridge, MA: The MIT Press, 2001).

2 Bill Moggridge, *Designing Interactions* (Cambridge, MA: The MIT Press, 2007).

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The nature of sound studies previously focused, as a standard discipline and curriculum, on the physical properties of sound and on acoustic features in engineering. In music schools, standard disciplines also included ethnomusicology, history of music, and sociology of music.[3] Today, sound design education is an emerging interdisciplinary area. We can link up sound studies with a number of diverse areas in modern science, from human–computer interaction to cognitive studies. Sound studies could contribute to the understanding of auditory, sonic, and communication activities from a much broader perspective than the "standard disciplines" already listed allow, heightening their effect on the future of design studies. Such an interdisciplinary focus would benefit from a practice-based, expression-driven study framework in design education. We believe that a strong connection between audio modality and design studies is growing dramatically, in parallel with new technologies, new practices, and technological innovations.

On the basis of these reasons, this article describes our view on formulating a framework for sound studies in design education. We do not try to provide a methodological framework for overall sound studies. Neither do we intend to present all perspectives in this field. However, we discuss guidelines that we have found, both through our teaching practices in design education and generally in art and design practices, to be potential references for developing successful and conceptual methodologies for incorporating sound as part of design education.

Creative Industries and Their Potentials

Practice and cultural changes in relation to digital media in everyday living result in the implementation of interdisciplinary product and service design. In higher education, such changes open up the form of studies in art and design to interdisciplinary modes of education. From this perspective, we would expect sound studies to reflect this interdisciplinary characteristic more in design education than it currently does, not only because of the changing role of sound in cultural practices but also because of the new industries that have emerged as a result of these cultural changes. We consider this notion in light of ongoing developments in creative industries.

The role of sound in product design and service applications has been extended further to become an important design element.[4] The scope of this extended role arises from technological developments, not just in new media, but also throughout the supporting creative industries. Creative industries have been defined and understood as industries that create, produce, and distribute goods that are both conceptual and practical, in which the creative arts and new media technologies converge in the application of

3 Trevor Pinch and Karin Bijsterveld, "Sound Studies: New Technologies and Music," *Social Studies of Science* 34, no. 5 (2004): 635–48.

4 Davide Rocchesso and Stefania Serafin, "Sonic Interaction Design," *International Journal of Human-Computer Studies* 67, no. 11 (2009): 905–06.

creativity and intellectual capital.[5] Note that, despite this "definition," no unique description of this industry fully considers the way in which complex interactions between cultures, economics, and technology in a globalized world—interactions dominated by symbols, texts, sounds, and images—influence and construct "creative industries."[6] Creative industries (also known as "experience industries" in Nordic European countries) comprise eight hubs: 1) advertising, 2) movies, 3) moving media, 4) fashion, 5) gastronomy, 6) tourism, 7) music, and 8) computer games.

The creative industries have already become a significant component of advanced economies, providing an opportunity for economic growth and increasing employment.[7] In most dynamic areas (e.g., digital media content), they represent an estimated $50 billion potential economic boost. As the fields themselves operate and grow, they influence, drive, and enable growth in other sectors and services, including finance, health, government, and tourism.[8] This value of the creative industries reflects the overall circumstances and challenges of the early twenty-first century; however, the United Nations Conference on Trade and Development (UNCTAD) also reports an official figure of $424.4 billion in sales for the creative industries in 131 countries in 2005.[9] The comparison of both economic values is a good indicator in considering the significant and growing role of creative industries on an international scale. Already, in dynamic economies, we can note the potential activities and the billion-dollar scale values and volume in the work of artists, researchers, designers, scientists, and students who become the main resources of this economic and cultural grand pyramid.

This brief look at the industry's status makes clear that auditory media, as well as other modalities, have become an important component in the content developed by the creative industries. Sound has always been a fundamental source for musical creation and clearly has a significant role in the music industry. In the broader context of creative industries, the role of sound and music is not limited only to music publishing; sound design is a necessary and essential part of many creative industries, from interactive art to computer games to movies, advertising, and mobile phone entertainment applications.

To summarize, the creative industry itself needs its own experts—specialists in art and design with extensive skills and knowledge to fulfill the related context, content, product, and service development needs in this constellation of industries. Thus, alternative frameworks for degree programs in higher education institutions should be developed for the related and supporting studies of sound in design education, so that graduates have the relevant and valued expertise to meet the current needs of the creative industries.

5 John Hartley, "Creative Industries," in *Creative Industries*, John Hartley, ed. (Oxford: Wiley-Blackwell, 2006); and United Nations Conference Trade and Development, "Creative Economy Report, The Challenge of Assessing the Creative Economy: Towards Informed Policy-Making.," http://unctad.org/en/pages/PublicationArchive.aspx?publicationid=945 (accessed November 22, 2012).

6 UNCTAD, "Creative Economy Report," 4.

7 Hartley, "Creative Industries," 96.

8 Ibid. 3.

9 UNCTAD, "Creative Economy Report," 115.

Rationale for the Development of Sound Studies in Design Curricula

To present our approach on sound as a design element, we consider Moggridge's arguments on design and interaction qualities as a means to deepen our understanding of why sound should be considered as part of design. The more common approach in design studies is to introduce necessary design qualities appropriate to the context of design. In addition to the most common qualities of usability, utility, satisfaction, and communication, designing for sociability also make demands in the design process to support social aspects of the product.[10] Artists and designers use design elements to attach communicative, functional, and aesthetic meanings to the artifacts, and we believe that sound can contribute in a variety of ways to enrich the qualities of the design, jointly supporting all the other design elements.

When considering expected design qualities, we should also consider the ways the design elements communicate with each other and with people through the products. Communication should present concise information and thus should include only necessary components. It has been long argued that rather than trying to increase information conveyed by presenting information in one modality (e.g., visually), cognitive load should be decreased through the use of coherent multimodal presentations that facilitate quick reactions.[11] We claim that sound can play an important role in achieving this goal because it can spread the cognitive load between sensory modalities, thus reducing the amount of information required on screen for visual processing.[12]

Meanwhile, a variety of categories of information can be presented with sound, which can also improve the usability, functionality, and attractiveness of the design. Sound can facilitate presented information in a dynamic range because our ears are capable of working with larger dynamic changes that sound generates. Sound also can be used as a very powerful design element for representing spatial information throughout sound-source distribution—gaining information about the physical location of objects by allocating sound sources—which could help us to keep our focus on multimodal levels in our interaction with designed products and to significantly reduce information loss and cognitive overload.[13] Incorporating sound as a design element can make information easier to understand, so that the most feasible responses can be performed in a very short amount of time to ensure the usability of the designed object. In addition, sound potentially presents pleasing and attractive qualities of the design in that, by its nature, sound can evoke emotions in users more easily than other sensory modalities. Sound can provide an alternative way to embed different states of emotions in design. Besides these features, sound provides opportunities that do not require

10 Moggridge, *Designing Interactions*, xiv .

11 Thomas G. Ghirardelli and Angélique A. Scharine, "Auditory-Visual Interactions," in *Helmet-Mounted Displays: Sensation, Perception, and Cognition Issues,* Clarence E. Rash, Michael B. Russo, Tomasz R. Letowski, and Elmar T. Schmeisser, ed. (Fort Rucker, AL: U.S. Army Aeromedical Research Laboratorty, 2009), www.usaarl.army.mil/publications/HMD_Book09/files/HMD_Book09.pdf. (accessed November 22, 2012).

12 Koray Tahiroğlu et al., "Embodied Interactions with Audio-Tactile Virtual Objects in AHNE," in *Haptic and Audio Interaction Design* 7468, Charlotte Magnusson, Delphine Szymczak, and Stephen Brewster, ed., (Heidelberg: Springer Berlin, 2012), 101–10.

13 Tapio Lokki, Ville Pulkki, and Juha Vilkamo, "Directional Audio Coding: Virtual Microphone-Based Synthesis and Subjective Evaluation," *Journal of Audio Engineering Society* 57, no. 9 (2009): 709–24.

visual focus in product usability; that "our ears are continuously active" is a widely recognized truism. Because we are much quicker to notice changes in the auditory domain, this feature has been used in design in many cases as a means of alert[14]—from microwave ovens to fire alarms.

All these features make sound an important consideration in product and service design in a variety of application domains, such as entertainment, communications, and office and household appliances. It serves as a design element and feedback channel for keyboard keys, for ATM machines, or for a system attaching safety seats for children in a car; for a speech output or comment input for messages; for emails or ring-tone alerts in consumer electronics; and to accompany actions in mobile phone or computer entertainment products.[15]

The changing role of sound as a design element also reveals an emerging need to extend the interdisciplinary characteristic of studies in higher education curricula and allows us to claim that sound should be introduced into a design curriculum. Developing sound design studies with such an emphasis has been of interest for many scholars.[16] In the following section, we present an overview of current sound design education by highlighting three different models in three different art and design institutions.

An Overview of Sound Design Education Experience

To ensure that sound has a role in design studies, we can look to current educational experiences and activities in design institutions; we focus on Media Lab Helsinki, Aalto University; École Nationale Supérieure de Création Industrielle (ENSCI) and the European Master of Arts in Sound (EMAS), a European joint masters degree in sound with partners Aalto University Finland, The Netherlands Film and Television Academy, Ecole Nationale Supérieure des Arts et Techniques du Théâtre France, Aubagne International Film Festival France, Ghent International Film Festival Belgium, ifs Internationale Filmschule Köln Germany, School of Arts Ghent Belgium and The School of Sound UK.

Interdisciplinary characteristics of sound studies began to play an important role in the curriculum when new media studies became part of design education in the Media Lab Helsinki, in the Department of Media at Aalto University. The mission of new media studies is to explore, discover, and comprehend the new digital technology and its effect in society; to find and exploit the possibilities it opens to communication, interaction, and expression; and to evaluate, understand, and deal with the challenges it poses to design and creative production.[17]

In addition to the cross-institutional academic network, a strong and vibrant contact with the industry is an important strength in the sound design studies at Media Lab Helsinki. In the

14 Stephen A. Brewster, "Non-Speech Auditory Output," in *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications,* 2nd ed., Andrew Sears and Julie A. Jacko, ed. (Boca Raton, FL: CRC Press, 2008), 220–39; Stephen A. Brewster and Catherine V. Clarke, "The Design and Evaluation of a Sonically Enhanced Tool Palette," *ACM Transactions on Applied Perception* 2, no. 4 (2005): 455–61.

15 Davide Rocchesso et al., "Sonic Interaction Design: Sound, Information and Experience," in Proceedings of *CHI '08 Extended Abstracts on Human Factors in Computing Systems* (New York: ACM, 2008), 3969–72; and COST SID W2, (Intergovernmental framework for European Cooperation in Science and Technology COST - Information and Communication Technologies ICT action: Sonic Interaction Design) "Working Group 2: Product Sound Design," http://sid.soundobject.org/wiki/WG2Product (accessed August 19, 2012).

16 Xavier Serra, Gerhard Widmer, and Marc Leman, *A Roadmap for Sound and Music Computing,* The S2S Consortium, ed. Xavier Serra, Gerhard Widmer, and Marc Leman (Barcelona: The S2S Consortium, 2007). 30

17 Media Lab Helsinki Courses, http://mlab.taik.fi/courses, (accessed November 22, 2012).

degree requirements of the MA program, independent studies are encouraged in which the student can participate in and complete commissioned projects with external partners under the supervision of the academic faculty. The practice-based nature of the pedagogy supports learning in real-life cases and provides the students with sufficient project management skills during their studies. The projects vary from open artistic assignments to commercial productions from both the public sector and private enterprise.

ENSCI has a slightly different approach to sound studies in that industrial and textile designs are the main focus in the curriculum. However, throughout its more than 25 years of experience in training designers with various profiles, the ENSCI provides a diversity of focus in design by being aware of the radical changes that digital technologies provide in the current age. The multidisciplinary education at ENSCI is based on artistic, literary, and scientific backgrounds; a practical teaching program, including projects with industrial partners; practice-based learning with professional designers; and a more personalized, custom curriculum for each student.[18]

Sound studies at ENSCI allow students to pay attention to the role of sound by studying the relationship that occurs between our environment and the creation of sound. Studies link the basics of acoustics and psychoacoustics, musical currents, and forms of art borne of sound recordings.[19] Sound studies take form under the general industrial design curriculum as part of the creative studio, enabling students to build sound constructions and design forms to create industrial or artistic objects. The creative studio provides alternative forms of practical exercises for students, including practical artistic and design projects in which the use of sound is explored from narration to fiction, from sound installation to audio museography, and from real-time audio graphics to sound orchestra devices/instruments.

From a broader perspective, a current trend in European education through the Bologna declaration has been to establish closer cooperation between institutions in Europe and a closer link between employment and education.[20] Earlier, S2S2 Consortium (Sound to Sense – Sense to Sound) published a roadmap for sound music computing research, which also included a framework for undergraduate, graduate, and postgraduate sound studies.[21] A new European consortium has been formed to establish a European Master of Arts in Sound (EMAS).[22]

EMAS proposes a two-year masters program in sound—an intensive education in the creative potential of sound and part of a multimedia practice. The curriculum emphasizes the development of creative practice, along with technical craft, and embraces research as essential in supporting self and creative development.

18 Ibid.

19 Media Lab Helsinki, http://mlab.taik.fi/ (accessed November 22, 2012).

20 European Commission, "The Bologna Process. Towards the European Higher Education Area," http://ec.europa.eu/education/policies/educ/bologna/bologna_en.html. (accessed November 4, 2012).

21 Serra, Widmer, and Leman, *A Roadmap for Sound and Music Computing*, 27.

22 EMAS, "European Master of Arts in Sound," www.emasound.org/ (accessed January 24, 2013).

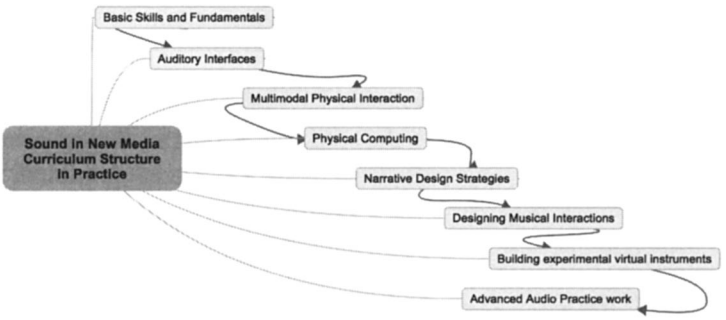

Figure 1
The modular path of studies in Master's Degree program in Sound in New Media, Media Lab. Helsinki, Aalto University.

The overall aim of the course is to produce practitioners who can work in the creative industries, who are not only highly skilled but also creative, critically aware, innovative, and professional in their approach. EMAS is a work in progress; beginning in October 2014, it will be launched as the first European joint masters degree for sound, created by a consortium of European universities, film schools, art schools, and arts organizations.[23]

According to our analysis of these existing graduate programs, which are relevant to our approach, we argue that as sound further extends its role, it moves away from being only an aesthetic element and includes the idea of musical aesthetics in any related product or service; we thus position its related education in a design-oriented education framework. Based on our assessments, we see a need to develop a more focused sound study program in design education. The study framework should incorporate not only post-production, editing, technology, and music studies, but also should be combined with overall design topics in new media and design studies. The creative/experience industry needs masters and experts who can integrate their multidisciplinary design knowledge and skills in their work both in the academy and in industry. Our approach involves focusing on the expanded role of sound studies in design education.

As the new aspects of sound studies are considered, the emerging multidisciplinary characteristic of the field becomes more visible. In the following section, we introduce practical results of a curriculum structure using student projects from a Finnish education perspective, thus emphasizing the role of the applied sound studies we propose in this paper.

Practical Results of the Sound Studies

In our discussion, we reveal a path of study for a master's degree program that covers a wide range of knowledge-building, from basic skills to physical computing, and from narrative design strategies to experimental virtual instrument design (see figure 1).

23 Ibid.

Figure 2 (top right)
Heikki Sillanpää's project work is based on getting sound samples in a computer environment and storing them in different channels. Following that computational model, the project sequences the sound samples in certain order while it allows choosing specific section where the sequencer begins to play. http://vimeo.com/16956281 (accessed November 22, 2012).

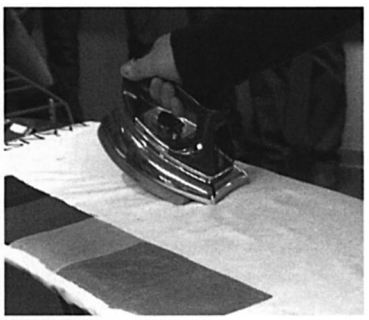

Figure 3 (above)
Matti Niinimäki's study project turns an everyday life object, iron, into a sound object. The iron is equipped with several sensors which make it possible to detect different infra-red gray scale values on the surface that iron contacts. These gray values and the acceleration of the iron are mapped to control parameters. It also gives tactile feedback based on the different patterns on the ironing board throughout vibrotactile actuator inserted in the iron. http://vimeo.com/19828686 (accessed November 22, 2012).

Figure 4 (bottom right)
Reha Discioglu, Piibe Piirma and Ferhat Sen designed three instruments inspired by Turkish cultural heritage using digital technology. The project uses the form-factor of the traditional instruments and augments the control and output layer throughout the physical computing methods and devices. http://vimeo.com/18722096 (accessed November 22, 2012).

This path of study is based on elective workshop courses. Students can attend to these courses during any period of the curriculum, which gives all the students an opportunity to go through the path from basic skills to their final thesis work. The starting point of this path, Basic Skills and Fundamentals, provides general knowledge about sound and music and aims to familiarize students with the use of computers in organizing, manipulating, and creating sound by introducing the basics of data flow programming language (see Figure 2).

Following the basic skills, the Auditory Interfaces module serves as an open platform to design and develop projects and theories around tangible aspects of interactions with sound. Multimodal Physical Interaction introduces the practices that allow for designing new ways for humans to interact through digital environments, keeping the sound as the centralized point of the interaction (see Figure 3). Similarly, the Physical Computing module develops concepts for prototyping interactions that focus on more advanced software programming and electronic assembling (see Figure 4).

Figure 5
Tero Vänttinen's project is an 8-channel sampler that records sound samples and makes it possible to control each channel individually. Sound samples are recorded through custom-made mechanical and analog instrument. The resulted sounds are also distributed to spatial audio setup, which brings in surround sound distribution surprises. http://vimeo.com/36148660 (accessed November 22, 2012).

Narrative Design Strategies explores human interaction with artifacts, investigating narrative strategies inspired by related film or game sounds. Designing Musical Interaction gives students an opportunity to learn how to process and organize sounds in a digital environment using various sonic experimentation strategies for interactive music performances, installations, and compositions (see Figure 5). Building Experimental Virtual Instruments approaches musical interaction through the programming code as artistic material, emphasizing the joy of creating using creative software. This module aims to make students familiar with building virtual instruments using various software and programming languages. The last module in this structure, Advanced Audio Practice Work, helps students to develop their final thesis subjects in relation to their major interests in the field.[24]

One of the Advanced Audio Practice Work efforts was the sound design for Kirnu, the Finnish pavilion in the Shanghai World Expo 2010.[25] Instead of a single, clear-cut client, the work was commissioned by a cluster of companies and design studios working in the project. The brief for the sound design team, consisting of students from the Media Lab and CM&T Sibelius Academy, required the creation of a seamless interior soundscape for the entire building. The sounds of Kirnu ranged from Finnish nature to folk, orchestral, and electronic music, giving each space its own color and atmosphere.

The sonic journey began at the entrance of the pavilion, providing the visitor with audible experiences of Finnish nature. The sound installation on the ramp leading to the exhibition space started with the sound of tingling ice, which slowly transformed into sounds of folk instruments. Sounds of spoken, contemporary Finnish poems moved across the space. Instead of using visible loudspeakers, students hid actuators behind the walls, turning the ramp architecture into a massive, immersive loudspeaker (see Figure 6).

24 Media Lab Helsinki, http://mlab.taik.fi/.

25 Resonator Helsinki, "Press Release," 2010, www.resonatorhelsinki.com/20100430-resonator-helsinki-kirnu-press-release.pdf (accessed January 24, 2013).

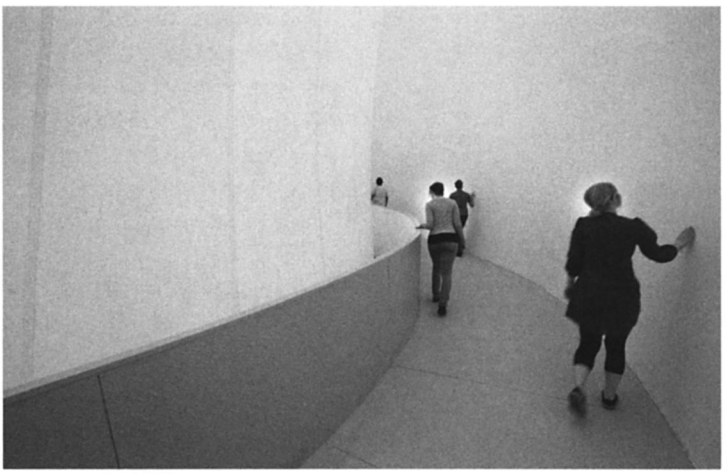

Figure 6
Kirnu, the Finnish pavilion in the Shanghai World Expo 2010. Photograph by Derryck Menere for Muotohiomo.

Conclusion

In this article, we have tried to formulate a framework for sound studies and emphasize its role in design education. In conclusion, we are confident that sound studies in design education can provide a functioning structure and opportunities for students to develop and apply their interdisciplinary skills and knowledge to create new and innovative interactive design solutions. We, of course, have not proposed a framework with a measurable outcome using scientific pedagogical methodologies; however, our framework indicates potential guidelines for further studies in sound education. This framework draws attention to the need to approach the creative design process with further consideration of sound as an important design element, recognizing that sound design is one of the emerging study areas in design education. Our overview of sound studies in three different forms shows how sound in design studies has played a role in existing curricula and activities.

All of these points lead us to an ongoing discussion about the principles and role of sound studies in a design practice. An important aspect of this discussion is that *designing with sound* is still not an easy process and not an easy task to appropriate for many applications—especially if we compare it to potential models in which sound studies are built in to discipline-specific fields, such as engineering or musicology. Designing with sound requires a continuous design process in which sonic exploration of design models can be drawn from a non-visual design environment. At the same time, during this sonic exploration, the contrasting forms of linear and nonlinear audio content structures reveal limitations as well. If *"everything is designed,"*[26] then we should note how the role of sound design, as described in this article, is getting more exceptional as it becomes more important.

26 Clement Mok, *Designing Business. Multiple Media, Multiple Disciplines* (San Jose, CA: Adobe Press, 1996).

We have shown how student projects, at least within a limited perspective, display that sound studies in design education can be innovative and can be more open to further steps and new ideas in artistic creation and design processes. Students can work freely with sound design ideas, ranging from the level of utopia to the level of reality, and without worrying about limitations established by any sound-specific rules. Students experiment in a real environment, taking a sonic journey to realize the outcomes of their ideas—most likely with unusual, unforeseen, and untold sound results.

The principles and framework we describe here are subject to elaboration and improvement. By positioning sound studies in design education as an emerging interdisciplinary field, with an emphasis on the multidisciplinary nature of new media studies, our proposal significantly differs from previous approaches to sound studies.

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