Materiality for Musical Expressions: an Approach to Interdisciplinary Syllabus Development for NIME

Rikard Lindell
Mälardalen University
P.O. Box 883, SE-721 23
Västerås Sweden
rikard.lindell@mdh.se

Tahiroglu Koray
Aalto University
PL 11000, 00076 AALTO
Helsinki Finland
koray.tahiroglu@aalto.fi

Morten S. Riis
Aarhus University
Nordre Ringgade 1
8000 Aarhus C
Denmark
mr@dac.au.dk

Jennie Schaeffer
Mälardalen University
Box 325, SE-631 05
Eskilstuna Sweden
jennie.schaeffer@mdh.se

ABSTRACT

We organised an elven day intense course in materiality for musical expressions to explore underlying principles of New Interfaces for Musical Expression (NIME) in higher education. We grounded the course in different aspects of materiality and gathered interdisciplinary student teams from three Nordic universities. Electronic music instrument makers participated in providing the course. In eleven days the students designed and built interfaces for musical expressions, composed a piece, and performed at the Norberg electronic music festival. The students explored the relationship between technology and possible musical expression with a strong connection to culture and place. The emphasis on performance provided closure and motivated teams to move forward in their design and artistic processes. On the basis of the course we discuss an interdisciplinary NIME course syllabus, and we infer that it benefits from grounding in *materiality* and in *the place* with a strong reference to *culture.*

Author Keywords

Design, Materiality, Performance, Place, Culture, Curriculum, Syllabus, Summer School, Education

ACM Classification

H.5.5 [Information Interfaces and Presentation] Sound and Music Computing, H.5.2 [Information Interfaces and Presentation] User Interfaces—Haptic I/O, K.3.2 [Computers and Education] Curriculum

1. INTRODUCTION

Course syllabus development has long been an interest for the New Interfaces for Musical Expression (NIME) community[5, 12, 11, 9]. These papers indicate that we must undertake a better understanding of underlying principles of NIME to create a course syllabus for NIME. Our discussion does not attempt to lay down a structured curriculum, but contributes to the discussion on education for our field.

To explore the possibilities to expand the field of new musical interfaces and underlying principles of NIME in higher education we organised an elven day intense course in materiality for musical expressions during the summer 2015. We grounded the course in different aspects of materiality: tangible materials, digital materials, electronics, programming language code, music, and culture heritage. We gathered master students from engineering, interaction design, sound in new media, and music from three Nordic universities: Aalto University in Finland, Aarhus University in Denmark, and Mälardalen University in Sweden. We wanted the students to explore the qualities and boundaries of the design of electronic music artifacts grounded in the theory of materiality, and to consider design, composition of a piece, and performance. The focus of the designs and artistic performance was linked to the themes of materiality, steel, fire, and transience. We trusted the students to perform live for the audience at the Norberg festival, the annual electronic music festival in the Västmanland region located at an abounded mine and ore mill with the stage in the Mimerlaven building (see Figure 1).

Figure 1: The Mimerlaven building during the Norberg festival. Photograph by: Frederik Hilmer Svanholm.

2. METHODOLOGICAL APPROACH

We approached a curriculum for NIME from an education practice perspective, providing a course as a syllabus design intervention agreeing with the action research methodology. Action research emphasizes the improvement of practice, and empirical founding of contributions. The strength of action research lies in its participatory approach, subject-subject relationship with the participants, and its intervention in a practice situation. Researchers form knowledge from a situation supplemented with subject participation where they distinguish the situation from both a theoretical and a practical perspective [1]. "Action researchers expect advances in theory or understanding to be consequences of their real-world interventions. In other words, they are inclined to see the development of theory or understanding as a by-product of the improvement of real situations, rather than applications as a by-product of advances in "pure" theory." [3] We see the students and ourselves this context as practitioners who had different roles in the course (designer, artist, engineer, and teacher), and simultaneously we were researchers in education. Our course helped, in collaboration with the students, to study the implications of a NIME syllabus, uncover our own perspectives on NIME education, and to lay a path for future endeavours.

3. MATERIALITY FOR MUSICAL EXPRESSION SUMMER SCHOOL

The course provided an opportunity for the students to develop a theoretical and practical framework, covering a wide range of topics from sound synthesis to physical computing with a hands on and minds on teaching philosophy. We gave the students abundant philosophical, theoretical, and practical input. Within interdisciplinary characteristic of the field, the course explored several related topics; designing prototypes with scrap materials to explore the design space, exploring the design process in a safe room (having their own small design studios), novel controllers and interfaces for musical expression, performance and composition strategies, physical interaction, mobile music technology, performance paradigms, and the utilization of sound synthesis techniques. The course dealt with these topics through the areas of intersection between different dimensions of human agency, technological agency, and new technological/social practices in art and design context. We introduced the critical theory of materiality considered the use of data in different domains, through investigating the materiality in the physical and digital dimension in music practice. Examining the digital object based on formal and forensic materiality within digital systems [10]. Historical materiality: From retro-mania to microtemporality [16]. Human, non-human and digital objects: An object-oriented ontological perspective [4, 8]. We consider the physical material (plastic, metal, wood, cardboard) interaction with computers [2, 18], programming language code as design material [13] and data as artistic materials [7]. We composed the course and the teams to support freedom of exploration in a safe environment to question the practice. Peschl and Fundneider [15] suggest that people create a context to train their patience and their ability to wait for the right moment, and to radically question themselves, to closely observe and listen weak and fragile signals, and to cultivate and incubate them in their designs. Lehrman and Ryan [12] have previously showed that the making of electronic music instruments is a way to combine technology and art in education with emphasis on interdisciplinary teams.

3.1 Enacting Course Syllabus

In this section we present cronologically how we enacted the course syllabus. The course included studies before and after the eleven intensive course days.

Prologue The students were provided with a selection of papers that framed the theoretical background of the course as preparation. The learning objective was to introduce the students to the critical theory of materiality.

Day 1 Course introduction including an excursion to Norberg, the fire ravaged forest, and the Mimerlaven industrial building, with the objective to instroduce the industrial culture context and its transience.

Day 2-8 Lectures and workshops at the Västmanlans museum[1], the region's museum in the centre of Västerås providing the course venue; design studios, lecture premises, workshops, and materials. Each day began at ten with lectures with workshops in the afternoon and during the evening ending at quarter to ten.

Day 9-10 The course moved to the Norberg festival. The students continue to develop their designs as a contribution to the festival. This allowed interaction with, and feedback from the audience during rehearsals, and grounding of the performance in the place.

Day 11 Project examinations through performances in the Mimerlaven building including the festival's main stage.

Epilogue The students submitted essays on their reflections over their instrument, composition, and performance. The three cases presented below are based on the students' self-reflection and our observations. Thus, through the participatory approach we involve the participants' self-reflection.

3.2 Design

The course started with a design process. Founded in a field study where the students got to know the Mimer Laven (Photo Elicitation of sites), the environment of the closed down mine and ore mill, and the fire ravaged forest in Västmanland (see Figure 2). The aim was to provide inspiration for design and an understanding of the spatial conditions for design. The initial lectures introduced the learning objectives of: Design thinking and design concept generation; Critical theory of materiality considering the use of data in different domains, through investigating the materiality in the physical and digital dimension in music practice; and the role of novel controllers and interfaces in the concept of musical expression with a detailed analysis of selected works, highlighting the technological, performance aspects. The students also did a design workshop, sketching and tinkering with scrap materials. The initial design phase of the course ended with a design critique session. The workshop became the initial divergent investigation of the design space, laying the foundation for the studio work.

3.3 Crafting and Composing

We provide hands-on experiences and reflections with what it means to build, and play (operate) a technological musical instrument. We introduced music and audio data flow programming with Pure Data (PD) and electronics tinkering with Ardiuno, including a session focusing on how to integrate PD and Arduino. Broader perspective on physical Interaction which will focus on the physicality of the body, positioning the musician/performer at the center of interaction as the active component for creating meaning and aesthetics of the music performance. Introduction to different sound synthesising techniques and compositions

---

[1]`http://vastmanlandslansmuseum.se`

Figure 2: The grand forest fire of the summer 2014. Photograph by:Frederik Hilmer Svanholm.

strategies. We also provided lectures on attending experiential qualities in software development, mobile performance paradigms, and exploration of site specific sound design and physical materiality. We gave an overview of composition and design strategies for time, space and sound, presenting the [democratic] open work: from Cage to the digital revolution. The learning objective were how to build an electronic music instrument and how to create a piece for it.

During this phase in the design process the students organised a second field trip to Mimerlaven to make firmer grounding in the place for their designs. This part of the course ended with test performances and design critique.

3.4 The Industry Perspective

The Crafting and Composing phase of the course included guest lectures from music technology industry represented by: Teenage Engineering – develop innovative music hardware product, Lidbo Audio Industries – an electronic music art, concept, and design studio, and C3N performance – develops tablet and mobile music and media apps.

4. CASE STUDY OF PROJECTS

We present three cases of projects that shows three different approaches to design, build, compose and perform. Theses diversified cases helped us understand the performative aspect of the course and syllabus.

4.1 They wish to speak to you

"They wish to speak to you", embracing chaos and failure in instrument design – Sebastien Piquemal, Tobias Mikkelsen, Oskar Mossberg, Figure 3.

Figure 3: Performance of "They wish to speak to you"

In this project the students described modus operandi as creating an assemblage of anything they could get their hands on:

"We decided to build a physical feedback loop, made by simply putting together disparate analogical audio parts : actuators, contact microphones and anything else we could get our hands on : electromagnetic transducers, small speakers, small amplifiers ... and just wiring it up so that we could get any interesting sound out of it ... from a process of reasoning and problem solving, we moved to an emergency process of free experimentation and embracing malfunction and serendipity."

The way of working was new to them, and brought new perspective to the actual composition and creation of the "machine" that could generate sound. In the process, there seems to be an intertwinement between the human and the machine, where also the machine has its say in the design process indicating the students' learning outcome both of the design process and the agency of who is the performer:

"This [for us] new way of working, deeply marked how the instrument we ended up designing worked. It was completely chaotic, very delicate and precarious. Feedback loops are usually calling for unpredictability, but here we also had bad connections, things that needed to be in contact to work, but were not really sticking together, and finally a completely different sound and behavior depending on the battery level of the amplifiers ... so that no matter how long we rehearsed playing with the system, it would likely be quite different on the day of the performance."

Their initial idea was to wire the whole building, turning the building into an instrument. Gradually as their project evolved after a series of disasters and intriguing failures, the grand scale became an intimate, delicate and fragile design. This was reflected in their composition for the instrument.

"[W]e identified two states in which we had different types of sounds, and trained in order to be able to easily stir the system from one state to the other. This gave us a bit of material to work with, but not enough to create an interesting piece. We felt like we needed to give a direction to the composition, making sense of the chaotic sounds produced by the instrument. Since the system was just a chain of speaker and microphones, we realized that by plugging-in an external audio source, we could use the system as both a speaker and an effect for that source. We then introduced a cassette player, playing a simple tape loop which provided an anchor to the piece. Suddenly we were able to navigate between chaos and order, and an interesting composition emerged on the very last day before the concert."

While digital instrument design is often user-centered drawing form the experience and practice in the human computer interaction and interaction design field, the students here report an artistic approach to instrument design with a connection to the place.

4.2 Still-Life

Valtteri Wikström, Marie-Louise Andersson

In the Still-Life project the students created a poem as a result of the initial design workshop: "Floating in the void nature's law breaks down a moment of the apocalypse." The poem served as a foundation for the projects design work.

"we strive for a complex atmospheric experience where a string instrument, voice and costume contradict, unify and connect. The visual appearance is equally important to the sound characteristics, with the singer suspended in mid-air floating above the ground. "Still-Life" could be interpreted as an investigation of a moment transforming into another dimension where gravity and time dissolves. Where a levitated black shape sings ghostly vocals interrupted by

Figure 4: Image from the performance Marie-Louise Andersson singing, wearing her still-life costume.

Figure 5: The motor striking the string of the instrument.

a droney string instrument."

The group firmly routed their aesthetic inspiration in the Mimerlaven building and the fire-ravaged forest. The forest wasteland implied a design for a costume and performance scenography with the vocalist levitated in wires a couple of decimeters above the floor. This is an indication of the learning outcome of the critical theory of materiality. The group shows a collaborative creative process producing a concept, a graphic score, and sounds through improvisation and discussions.

"Decisions during the design and artistic process were based on discussions, establishment of certain starting points or ground rules, followed by intense experimentation, evaluation and re-examination. The principle was having live and acoustic sound sources processed by technology, but an openness to changes and modifications based on the results of experimentation was central in the iterative process."

Like the previous group, this group decides on an analogue and semi-acoustic sound source. However, they rely on real-time Fourier transform to shape the vocal sound, removing the fundamental harmony. They demonstrated the learning outcome of implementation.

"The vocals [were] disturbed by an increasing intensity in texture, distance and closeness by the appearance of the string instrument. The string instrument is structurally chaotic, controllable but unable to sustain. The aesthetic outcome of the instrument evolves from a simple metal box chosen from its resonance qualities and response to the vocals. With an internally installed elastic string driven by a free-hanging motor, the instrument is controlled by tilting

the box. A contact microphone is used to pick-up the sound of the string, which is processed by an analog resonant filter controlled by a random process."

The excerpt above show that this group also worked with the precarious and the unstable. In contrast to *They wish to speak to you*, they established a concept and, through improvisation and experimentation, they created a graphical score of circles and dots providing a structure for the performance.

4.3 Interruption

"Interruption" a piece for the Mimerlaven, Norberg Festival 2015 – Ben Eyes and Laurits Jongejan[6].

Figure 6: The performance of Interruption on the Mimerlaven main stage.

This project was grounded in the Mimerlaven building and its heritage and the history of the surrounding area. They used the first two days of the course including the tinkering design workshop to patiently explore and refine the design and artistic concept.

"[The Mimer building], was very inspiring and gave us many ideas including the ideas of a cathedral, the industrial history of the site, the sound of industrial processes, industrial ghosts and the heritage of the building and its place in history."

The quotation point at the students discussion and inclusion of the impression of the building in their process. It is interesting to add that during those discussion we observed a thinkering with a raw model based on provided scrap material, that was constantly altered, thus they demonstrated the learning objective of design.

"These themes were then narrowed down and distilled into the main ideas of silence and interruption. The long reverb time of the building would allow us to play with silence, stopping sounds and allowing the building to become part of the piece and instrument as it resonated and reflected sound. This was to be an important theme both for the structure and also in the acquisition of sounds for the piece."

The interruption concept emerged during the design process from a plethora of different concepts, connecting the design of the instrument to the interruption of the production at Mimerlaven in 1980.

"The idea of interruption, that the instrument would not generate sound itself but become a way of stopping sounds is important. We were going to make an instrument that would not be sound generating, but instead be able to control the amplitude of a sound. [...] The idea of a *light gate* came about. This would convert sound to light and allow interaction of the sound in the light domain."

The light gate instrument was built using the Arduino to convert the digital audio signal from Ableton Live via the

Maxuino Max 4 Live plugin to a light output signal. The light signal was converted back to a control signal using a photoresistor. Their artefact demonstrates the learning outcome of implementation.

The group decided to use sounds and field recordings from the building and its surrounding in their piece. They decided against synthesis making a piece entirely form sound of and in the building, and processing the sounds using the building as a seven second long reverb.

"Field sounds of the building where taken using a portable recorder. Large tanks, metal pipes and other parts of the building were struck with wood or hit and manipulated. Clanking chains, large heavy door locks and atmospheric sounds were taken. We were very fortunate as whilst recording was taking place a large storm hit the building. This resulted in a large amount of rain water coming down a storm drain into the basement. This recording was used in the finished piece."

The group composed Interruption as a duet between the light gate and Ableton Live using a launch pad. The launch pad was used to play the percussive sounds whereas the light gate had a multi-sampled string recorded in the Mimerlaven.

"We were careful to use and highlight the reverb and resonance of the room. The idea that the room was to become part of the instrument was important in our original discussions. Sounds were edited into rhythmical and asymmetrical loops. These would form the foundation of the piece that would in turn control the light and the amplitude of the string sound."

As the shape of the instrument and the sound space emerged the group relied on improvisation and rehearsal to "sketch out" their performance.

This group extended their own skill and took aid and guidance from students in the other groups, for instance from a violin player and from a programmer. The clear concept and the thorough design process appears to have supported the group's work and their communication with the outside help.

5. FINDINGS

What constitutes a syllabus for a NIME curricula?

The course theme and field trip combined with the design workshop helped the students to generate design and artistic concepts. It appeared that the place had a more profound impact in the design and artistic process than we first anticipated. Furthermore, dealing with group dynamics played a vital role for interdisciplinary teamwork.

Some of the teams decided early on the theme, and went from theme to design and build their instrument. For instance, one team connected –a postmodern sense of– worship to the cathedral like building. Drawing from the course theme of fire, they decided early in the process to use heat sensors as input. Instead of collaboratively work on the concept through design, they started to theorize about possible designs using a heat sensor. Eventually, the different skills and repertoires of the team members helped them to build an instrument and compose a piece as a sum of individual efforts. Despite supervisors' and team member's frustration of running out of time debating the heat sensors, they decided –as an extra effort– to rely entirely on their custom built hardware and software. Their design resulted in a performable interactive installation. One of the group members who demonstrated mastery with technology, generously helped the other groups in their struggle with technology.

Another group deiced early in the process to build their instrument, without a thorough exploration of the design space. In this group one member took an elucidate lead. Judging from their action this was almost an engineering approach, to solve the problem of building an instrument. "This is an instrument, right?" explaining why there must be buttons. The other two members showed frustration and worked on other aspects of the design and composition. "I have tried to contribute, but my problem here is that I am not happy with the project we did. I do not want to be rude, but I had a hard time working [in the group]. Our group was not what the three of us were expecting, and working was challenging." This quotation shows friction in the group collaboration.

The students in these two projects appeared to produce artefact, piece and performance as a sum of individual contribution instead of a collective effort, in stark contrast the three cases reviewed above that showed an intimate collaboration between the group members. Group members who took a dominating role in building the designs seemed to practice or expand their skill instead of exploring the boundaries of the design of digital instruments. Despite the problems of different perspectives of the context this team successfully performed a piece with their design portraying a strong connection to the place and its history.

With the starting point in an embodied experience of the place, the students created design concepts, for instance the concept of interruptions. The design workshop critique session was the end of the beginning of their initial design process. They continued to explore and refine their concept, initially in concrete material, then gradually expanded with electronics, code, and sound until they converged to *interruption*. They showed mutual respect for each other's skills and they did not hesitate to ask for help. For instance they had very limited previous experience in programming and this was their first time to work on a substantial project with the Arduino and electronics. The Still-life project also showed a strong mutual collaboration constantly exploring, first their concept, and then the implications of their concept. The members of this group showed a rhythm between collocated collaboration and individual work at different locations. They also had a rhythm in creating the design, piece, and performance including a costume for the performance. Their design was a digitally controlled analog or semi-acoustic instrument. In the "They wish to speak to you" project the initial design was firmly based in the site. They wanted to make the whole building to resonate. At the same time, they wanted to criticize strong connection to technology in their earlier work with for instance programing Python, MaxMSP, PureData, or SuperCollider. Where the Interruptions project had a disciplined design process and Still-life a strong artistic idea, the They Wish to Speak to You showed a constant chaotic tinkering with the design material, with constant anxiety of failure. They stepped collectively out of their comfort zones and in their design and piece criticized what constitutes an electronic instrument. Each design, composition and performance showed an intertwined relationship between the place and the design concept, artistic idea and performance. We thought that the underlying concepts of the theme connected to the site would, but a general inspiration the artistic and design processes similar to the still life project. However, in the other projects in the course cases we found anticipated indications of an artistically strong connection to the site and the building itself. For instance, making the whole building to resonate or using sounds solely produced in and from the building. The students organised a second field trip to Mimerlaven which further indicates the importance of the place. One initiated person from the audience commented the performances to be surprisingly theatrical with strong

narratives rather than focus on new interfaces or technology.

6. DISCUSSION

The course theme in materiality, transience, and place provided starting point and direction for the design of the artefacts and works. The strong reference to the culture and the place provided thought-provoking projects in conjunction with the conclusions of Özcan et al: "We believe that an approach to student artwork that employs references to the surrounding culture rise to more intellectually stimulating and creative student projects." [14] Furthermore the importance of place emerged during the course, too, shown in the students initiative for a second visit to Mimerlaven. The discussions during the lectures were about the relationship between technology and possible musical expression - e.g. who is composing or performing? Us humans or the technology? The the 3 case studies above reflect these questions - because they somehow reflect and stage these unresolved questions through a notion of fragility. Fragility in terms of not being able to fully control a musical outcome - but instead understand the relationship between musician and machine as a dialog and a negotiation - something that is constantly evolving. We could see that on opening for this fragility was that the course provided a context where the students had to radically question themselves and their way of working. In "They wish to speak to you" a radically different approach to feedback loop compare to the Rosli et al. Ensemble Feedback Instruments [17]. In our context the feedback loop represented the delicate, fragile, and chaotic, in the performance the audience intimately gathered around the artists. Rosli et al. delineates the mathematical topology and technological implementation of their design. The students papers and essays show that they tended to observe closely and to listen to weak and fragile signals and to cultivate and incubate them, in line with the ecology of openness for radical innovation [15].

7. CONCLUSIONS

The interdisciplinary approach helped us uncover our own assumptions about NIME and how the students expressed their ideas in text and speech about NIME through the course as an intervention in the students' education curricula. Lehrman and Ryan [12] have previously showed that the making of electronic music instruments is a way to combine technology and art in education with emphasis on interdisciplinary teams. The outcome of the students projects indicates that the emphasis on performance, in agreement with Leeuw and Tamminga [11] supported and motivated the projects to move forwards, especially for the groups that got stuck. The goal of producing an artifact and a piece provided purpose and propelled the projects forward. Instead of using a NIME syllabus as means to combine technology and art, we infer –based on our findings– that combine technology, design, art, and performance is a good way to make a NIME syllabus. Thus, NIME syllabus need many different curricula grounded in different fields. An interdisciplinary NIME syllabus benefit from grounding in *materiality* and in *the place* with a strong reference to *culture*.

8. REFERENCES

[1] B. Alterhaug. *Action Research a Nordic Perspective*, chapter Improvisation, Action Learning and Action Research, page 134. Høyskoleforlaget, 2007.

[2] J. Bergström, B. Clark, A. Frigo, R. Mazé, J. Redström, and A. Vallgårda. Becoming materials: material forms and forms of practice. *Digital Creativity*, 21(3):155–172, 2010.

[3] W. Carr and S. Kemmis. *Becoming critical: education knowledge and action research*. Routledge, 2003.

[4] D. Daniel. What is a digital sound object? *O-Zone: A Journal of Object-Oriented Studies*, pages 84–96, 2014.

[5] G. D'Arcangelo. Creating a context for musical innovation: A nime curriculum. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 46–49, Dublin, Ireland, 2002.

[6] B. Eyes. How to stop sound: Creating a light instrument and âĂŸinterruptionâĂŹ a piece for the mimerlaven, norberg festival 2015. In *Proceedings of the International Conference on New Interfaces for Musical Expression*.

[7] J. Freeman. Crafting interactive systems: Learning from digital art âĂŞ position statement. 2013.

[8] G. Harman. On vicarious causation. 2013.

[9] J. Harriman. Start 'em young: Digital music instrument for education. In E. Berdahl and J. Allison, editors, *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 70–73, Baton Rouge, Louisiana, USA, May 31 – June 3 2015. Louisiana State University.

[10] M. G. Kirschenbaum. *Mechanisms: New media and the forensic imagination*. Mit Press, 2008.

[11] H. Leeuw and J. Tamminga. Nime education at the hku, emphasizing performance. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, Ann Arbor, Michigan, 2012. University of Michigan.

[12] P. D. Lehrman and T. M. Ryan. Bridging the gap between art and science education through teaching electronic musical instrument design. In *Proceedings of the 2005 conference on New interfaces for musical expression*, pages 136–139. University of British Columbia, 2005.

[13] R. Lindell. Crafting interaction: The epistemology of modern programming. *Personal and ubiquitous computing*, 18(3):613–624, 2014.

[14] O. Özcan, E. Akdemir, M. L. O'Neil, and A. A. Ünlüer. Prayer bead gestures and television: A case study on cultural inspirations for interaction art education. *Leonardo*, 42(5):428–432, 2009.

[15] M. F. Peschl and T. Fundneider. Spaces enabling game-changing and sustaining innovations: Why space matters for knowledge creation and innovation. *Journal of Organisational Transformation & Social Change*, 9(1):41–61, 2012.

[16] S. B. Pold, C. U. Andersen, and M. S. Riis. A dialogue on cassette tapes and their memories. *A Peer-reviewed Journal About*, 3(1), 2014.

[17] M. Rosli, K. Yerkes, M. Wright, T. Wood, H. Wolfe, C. Roberts, A. Haron, and F. Estrada. Ensemble feedback instruments. In E. Berdahl and J. Allison, editors, *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 144–149, Baton Rouge, Louisiana, USA, May 31 – June 3 2015. Louisiana State University.

[18] J. Schaeffer and M. Palmgren. Prototyping in the in-between – a method for spatial design education. In *2016 Design Research Society 50th Anniversary Conference Design+Research+Society*, Brighton, UK, 2016.