

Sounds out of Bounds: Exploring Sound, Music and Learning with Modular Synthesizers

Report by Heidi Chan (YorkU), Kurt Thumlert (YorkU), Jason Nolan (TMU) & Aida Khorsandi (YorkU)

What is this research about?

With the support of the Helen Carswell Chair in Community Engaged Research, the *Sounds out of Bounds* project provided modular synthesizer instruments, curriculum, and faculty training to Community Music Schools of Toronto (CMST) to support youth-directed engagement in the practice of modular synthesis. Our research focused on a 3-day CMST instructor training event (led by PhD student, Heidi Chan, with the assistance of PhD student, Aida Khorsandi) at the RE/Lab. This project enabled CMST instructors to learn the principles of sound synthesis, investigate the properties of sound, explore the elements of music, and make music together. Synth systems and curriculum were later used during the CMST summer music camps, and this research project has fed forward to support CMST's 'Synth Club' at Regent Park as well as other research partnerships.

What did the researchers do?

The phenomenon of modular synthesis has expanded opportunities for artistic innovation, enabling diverse communities of practice to unsettle aesthetic hierarchies and disrupt barriers to participation in music-making worlds. Modular synthesizers are comprised of component modules with separate functions, and modules are 'patched' together in an open-ended manner using cables to shape and modulate sound and make music. Modular synthesizers provide non-linear pathways for learning with/about the properties of sound and the elements of music, and players build soundworks from 'the ground up' in a manner that does not privilege any one culture or aesthetic perspective (Thumlert, Nolan & Honisch, 2023). In bringing modular synths to CMST, our research questions focused on what and how people learn through engaging the practice of modular synthesis; what kinds of challenges, inquiries or collaborative practices might emerge through play and learning; and how we might learn from the workshops to refine materials, tools and curriculum based on research findings.

Hardware deliverables included two complete Eurorack synthesizer racks equipped with modules central to skilled practice: audio oscillators, filters, envelope generators, amplifiers, sequencers, function generators, low-frequency oscillators, white noise generators, and

What you need to know:

Learning with modular synthesis supports idiosyncratic modes of engagement and open-ended inquiry with materials. There is no 'one-size-fits-all' approach to learning, interactive making and/or composing with modular synths.

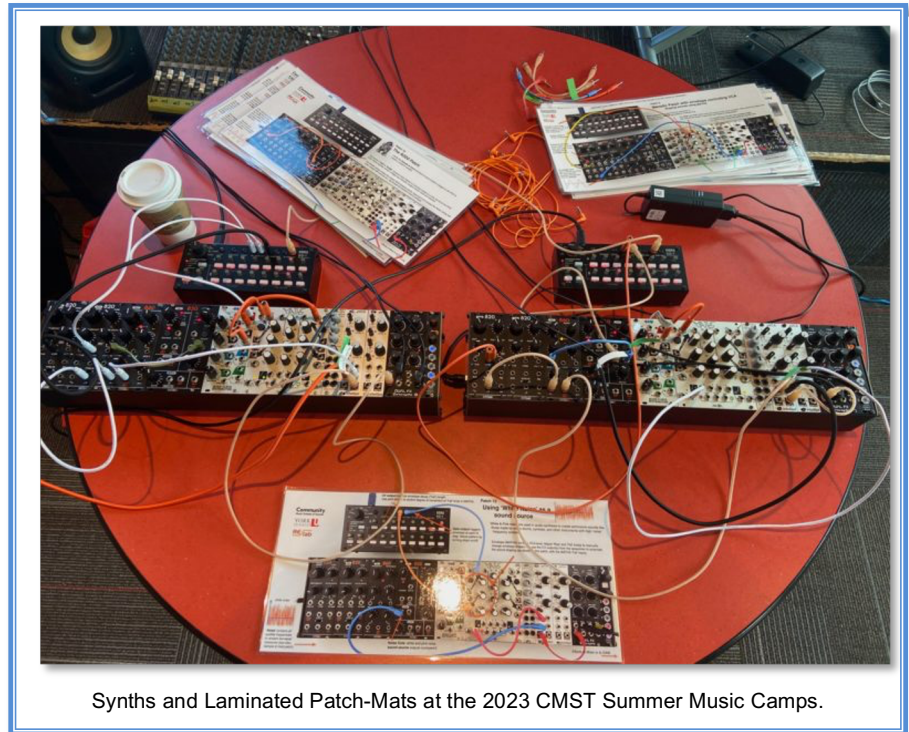
Working with modular synths, participants explored the fundamental properties of sound – from the ground up – finding common relations between electronically generated sound and acoustic instruments and other sound-making materials.

This Carswell research project has led to a CMST 'Synth Club' at Regent Park.

delay/reverb effects; two System80 Drum Machines for Eurorack (based on the landmark Roland 808 Rhythm Composer); patch cables; one 8-channel mixing board with audio interface; one 8-channel headphone mixer; and 8 headphones.

CMST Curriculum and Workshops:

The researchers provided a complete curriculum that guides CMST faculty in the learning the principles and practices of sound synthesis. Curriculum was introduced through the three-day CMST faculty workshop event, led by York research assistant and musician, Heidi Chan. Hands-on workshops provided modelling & apprenticeship to implement curriculum while inviting instructors to learn modular synthesis through exploration, open-



ended inquiry, and collaborative sound-design, supported by [patch-templates](#) and a [website](#) – with a suite of instructional videos and suggested CMST activities – developed by the research team to support CMST instructors after the three-day workshop event.

The 3-day modular synth workshop introduced CMST faculty to the instruments, instrument functions, patching techniques, and sound design ‘workflow’. Our research participants were all experienced musicians-educators from diverse backgrounds with various musical interests and expertise. Accordingly, the research team let participant questions and curiosities guide the process of hands-on engagement with the synths. Throughout the workshop, CMST faculty continuously considered and discussed how they might variously use the instruments and curriculum with children, in relation to sound design basics, music composition, or situating the synths within wider music performance ensembles or song recording projects.

During the first day, principles of sound synthesis were demonstrated using both electronic tools and acoustic instruments (e.g., ukuleles and flutes), where participants explored how pitch, volume, timbre, and sound/envelope shapes worked across the different instrument interfaces and structures. In this context, participants were introduced to the different system modules and their functions in relation to the properties of sound and elements of music. This included an exploration of what discrete modules ‘do’, signal flow, wave forms (sine, sawtooth, triangle, and

square waves), tuning oscillators and using the sequencer to control pitch (make melodies), and basic patching and modulation techniques.

During the second day, participants explored the use of our laminated patch guides. Each guide modelled a point of departure for creating a patch or exploring a patching technique, as well as more complex cards that demonstrated parametric relations for voltage control among different modules. Patch guides modelled signal flow and patch techniques related to pitch control, use of the LFO to modulate pitch, ornaments, or other module functions (e.g., filter cut-off); using clocks, LFOs, and the function generator to shape the rise and fall (attack/decay) of a sound; using the filter for timbral design and movement; using white noise as a sound source; sample and hold utilities; basic FM (frequency modulation) synthesis and so on.



Example of a laminated patch guides showing sample and hold technique.

During these sessions, participants used their musical knowledge from other contexts to make and test hypotheses about how the synths functioned and what they could do and create with them, as well as explored learning opportunities through hands on, interactive, hit-and-miss processes. Different participants explored the systems in different ways, based on their own interests or own favored modes of inquiry, or by trying to create sounds that resembled electronic music they had heard in the past.

Day-three instruction was designed to reinforce learning from the previous days and to permit exploration, improvisational play, and inquiry through sound design. Participants worked in small groups on the different systems and shared their learning and patches. The final project included creating an ambient drone patch on one system, modelled by Heidi, and involved re-creating a drone patch on the other rack. Questions posed by participants during the final session included how to compose and put together a 'song'; integrate the synths with other instruments in classroom contexts; and sync the Eurorack system with DAWs and connect other instruments or controllers with voltage-control pitch and gate outputs to the Eurorack system

(e.g., keyboards, MPK controllers, etc.). One CMST instructor patched an electric tenor guitar through a pre-amp module that allowed the instructor to control the pitch of an oscillator and the sound shape using an envelope follower. Again, many of the CMST faculty questions explored the possibilities of adapting the synths for classroom use for CMST students. They also discussed how their students in different age ranges might respond to the sounds made by modular synths, and how they might model modular concepts in fun ways for children.

What did the researcher find?

The research team documented learning challenges and opportunities through field notes, which informs our workshop narrative above. Along with field notes, we invited participants to fill out a short post-workshop survey that allowed them to reflect on the workshop, the curriculum, and their own inquiries and making with instruments. Overall, participants enjoyed and appreciated the hands-on approach to learning and inquiry. In the survey we found that, while all participants were interested in the practice, they were fascinated by different aspects and unique applications, from sound design to music making to integration of tools with ensemble forms or music composition using DAWs or other controllers. One common perspective, shared by most of the participants, was that working with modular synths allowed them to explore the basic properties of sound and map out relations between electronically generated sound and acoustic sound, and other sound-making materials and instruments. One participant referred to how modular synthesis helped them “think about sound as a raw material” while another appreciated “the closeness [of] working with sound in its most basic form, like sculpting sound”.

Participants provided very different views on learning opportunities and challenges, and how they might teach the curriculum at some point (e.g., some participants found the patch guides very useful as points of departure, or “stepping stones” for workflow, while other participants preferred more open-ended experimentation). Productively, each survey participant suggested or outlined quite unique approaches for using or integrating modular synths in CMST contexts.



While we did not research the CMST summer music camps where the modular synths were used, two members of the research team participated during the summer camps in supporting roles as just-in-time/on demand resources and fellow music makers.

This Carswell research project has led to a CMST ‘Synth Club’ event at the Regent Park site. CMST is also included as a partner in a York Catalyzing Interdisciplinary Clusters (CIRC) project: *Designing Sound Futures*.

How can you use this research?

This research explores the affordances of modular synthesis to rethink educational and community relationships while supporting new forms of sound-based inquiry, music learning, musicking, and making/learning through materials-centred inquiry (McBride, 2018). As noted in our findings, our curriculum enables learners to make analogies between electronic and material/acoustic instruments, giving us fresh insights into the fundamental properties of vibrotactile materials across contexts and aesthetic environments. Our research resonates with CMST goals for inclusive and innovative programming; culturally appropriate learning opportunities; and accessibility for learners with disabilities and for youth who, in traditional educational spaces, may be marginalized from taking authentic roles and identities as artistic makers, composers, sound-designers, and producers of art (Thumlert & Nolan, 2019). We welcome the use of our open-access curriculum materials and models, which can be found at: designingsoundfutures.org

About the authors

Heidi Chan is a musician and researcher based in Toronto. She is currently completing her Ph.D. in Ethnomusicology at York University, researching the impact of digital sampling technologies on the development of world music over the past four decades, and is graduate assistant on a number of research projects at York University and the Responsive Ecologies Lab at Ryerson University. An active member of Toronto's diverse music scene, she is principal bamboo flutist for Japanese folk ensemble *Ten Ten*, and produces and performs experimental electronic music under the name Bachelard. She is also a sound designer and composer for theatre, dance, and film, and has participated in productions across Asia, Europe, and North America.

Kurt Thumlert (PI) is Associate Professor in the Faculty of Education at York University, executive member at the Institute for Research on Digital Learning, and research associate at the Responsive Ecologies Lab. Kurt is a member of the Canadian Accessible Music Instruments Network (CAMIN).

Jason Nolan (co-PI) is autistic, holds the John C. Eaton Chair in Social Innovation and Entrepreneurship and directs the Responsive Ecologies Lab, and is Associate Professor in the School of Early Childhood Studies at Toronto Metropolitan University. Jason's research focus centre on inclusive musicking practice in formal and informal learning environments.

Aida Khorsandi is a doctoral music student at the School of AMPD at York University. Aida's research focuses on haptic engagements in musicking in relation to the interface and instrument design, interactivity, and accessibility. She uses found objects, samples, Max MSP and Ableton

and modular synthesizers, and other new technologies in her academic research and creative practices.

Keywords

learning with sound; modular synthesizers; modular synths; sound design; sound synthesis;

Citations

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About the Helen Carswell Chair

[The Helen Carswell Chair in Community-Engaged Research in the Arts](#) is a partnership between York University's [School of Arts, Media, Performance and Design](#) and [Community Music Schools of Toronto](#). This partnership is dedicated to community cultural development in the underserved neighbourhoods of Toronto. We facilitate and conduct rigorous academic research which explores the benefits of community music programs and the links between music and learning. The goal of our work is to significantly benefit children from high-risk neighbourhoods and to fortify community music programs globally through publications and knowledge mobilization. We especially seek to engage and help drive new knowledge and practice to community-based groups serving children in the Jane and Finch community.