Children, Youth and Environments 22(2), 2012

Nessie the Hydraulophone: A Water-Driven Musical Object for Children

Jason Nolan
Early Childhood Studies
Ryerson University

Steve Mann
Electrical and Computer Engineering
University of Toronto

Danny Bakan
Faculty of Education
University of British Columbia

Citation: Nolan, Jason, Steve Mann, and Danny Bakan (2012). "Nessie the Hydraulophone: A Water-Driven Musical Object for Children." *Children, Youth and Environments* 22(2): 263-272. Retrieved [date] from http://www.colorado.edu/journals/cye.

Abstract

Developed by Steve Mann, "Nessie" the Hydraulophone is a water-driven, interactive musical object that provides children with open-ended and unstructured creative play opportunities with water and sound. Children have interacted with Nessie in a variety of spaces including the Canadian National Institute for the Blind's (CNIB) outdoor classroom, Ryerson University's Early Learning Centre, the Ontario Science Centre, and various public outdoor play areas in the Toronto area. In collaboration with the Experiential Design and Gaming Environments Lab's research on sensory play and disability, this field report documents Nessie's development, implementation and potential as a research object.

Keywords: early childhood studies, children with disabilities, play, sensory play, informal learning environments, autonomy

This field report introduces "Nessie" the Hydraulophone[1], a water-driven, interactive musical object created by Professor Steve Mann, an engineer at the University of Toronto. In collaboration with Professor Mann, Professor Jason Nolan, director of the Experiential Design and Gaming Environments (EDGE) Lab, is exploring Nessie's use as part of our larger program of inquiry into sensory play and adaptive design for children with disabilities.

In 2004, Nolan saw Mann's first prototype of Nessie the Hydraulophone and immediately recognized its potential as a technology that would support sensory play and exploration for children, especially those with special sensory needs. Since then, we have given children and adults the opportunity to experiment with various Nessie prototypes in many public spaces before we finally brought it to Ryerson University's Early Learning Centre. From the first splashes, children are engaged with sound and musical creation. The musical sounds brought forth from Nessie by gleeful hands are a soundtrack for an emerging inquiry. From a pedagogical standpoint, Nolan emphasizes the importance of Nessie in relation to the Reggio Emilia approach to early childhood learning, which stresses community-based, direct, hands-on co-exploration, co-discovery and self-directed play through touching, moving, hearing, seeing and listening (Pope Edwards 2002).

Our initial observations, along with feedback and comments from participants, have informed the design and development of the technologies used in Nessie's current iteration. The most important changes have been to modify Nessie so it can function in multiple environments, making it more portable and adaptable. Nessie can now float in water, can be placed on an accessible platform or table, or laid out on the ground. Mann has taken Nessie to parks and early learning centers across Canada, where it has been featured in a number of public spaces. We explore how Nessie, as an object situated in early learning environments, functions as an approach to play-based learning and research.

Hydraulophones

The hydraulophone[2] is the first of a suite of instruments built by Mann as part of ongoing research and exploration of technology, the senses, and the body (Mann 2007; Mann and Niedzviecki 2001). His physical "organology" experiments have yielded musical instruments based on the five elements of earth, air, fire, water, and the mind; the instruments include chordophones, hydraulophones, eerophones, plasmaphones, and quintephones (Mann, Jenzen and Post 2006).

Hydraulophones represent a class of water-driven, interactive musical objects intended to provide children with creative, open-ended opportunities to play as they interact simultaneously with water and sound. Children can control the sounds produced by the hydraulophone through physical contact with the water in a colorful fountain. The hydraulophone was inspired by the water sounds we hear in

[1] http://en.wikipedia.org/wiki/Hydraulophone

[2] The hydraulophone is marketed as "Aquatune" by White Water West (http://www.whitewaterwest.com/aquatune.html) and as Hydrophone by SCS Interactive (http://www.scsinteractive.com/HydroLine_HydroPhone.html).

our everyday lives: plumbing fixtures such as faucets and toilets often produce sounds in the form of water hammer, “singing pipes,” oscillating valve seats, and water whistling through pipes. These sounds can be attributed to a wide variety of different phenomena; in many cases, at least some of the sound originates from matter in its liquid state. The hydraulophone combines the simplicity of the piano with an interface similar to that of the tin flute or recorder. Users play the hydraulophone by stopping the jets of water with their fingers or hands. By blocking multiple jets, they can even play chords. Small hydraulophones like Nessie, which is shaped like a sea monster (Figure 1), can float freely in the water, so children can play their favorite songs while playing in a pool.

Figure 1. Nessie the Hydraulophone

Larger versions can be mounted in or near any wading pool or can be installed as a separate “splash pad” in a water-play area. These are ideally suited for use in public parks, because the array of water jets forms a self-cleaning keyboard instrument that can be shared with strangers without the usual risks of cross-contamination that might occur if another instrument like a piano were left in the middle of a park.

Nessie in the Park, the Ontario Science Centre, and the Canadian National Institute for the Blind’s Outdoor Classroom

Sensory play is an important part of how children build and gather knowledge about the world around them. This was evidenced as Nessie traveled to many early learning centers around Toronto, as well as public parks such as Grange Park behind the Art Gallery of Ontario (Figure 2). In these public settings, we observed children and their caregivers intuitively playing and interacting with Nessie without music lessons, directions, or instructions.

Figure 2: Nessie in the wading pool in Grange Park, Toronto

In 2006, the FUNtain sculpture, the largest hydraulophone, was unveiled for visitors at the Ontario Science Centre (OSC). It consists of 24 pipes and two hydraulophone consoles[3] (Figure 3). Situating the FUNtain at the entrance of the OSC enabled free access for users at any time, even when the OSC was closed, and allowed users to play and explore sounds in large groups amid the spray of the water jets. Mann's hydraulophones have also been on display at various locations, including the Chicago Children's Museum (Gildiner 2009).

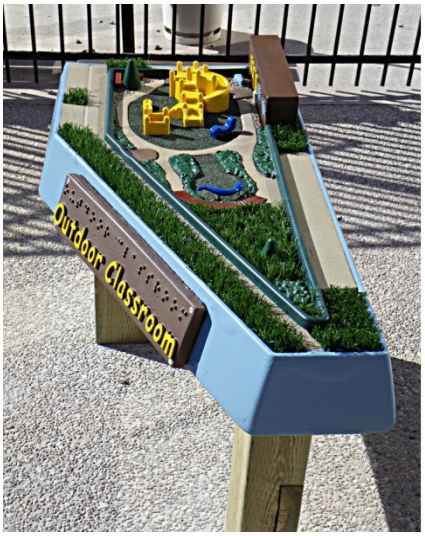
Figure 3. The FUNtain at the OSC

[3] See http://wearcam.org/osc/opening/ http://en.wikipedia.org/wiki/Ontario_Science_Centre#Ontario_Science_Centre_aquatic_play_fountain

The Canadian National Institute for the Blind's (CNIB) Outdoor Classroom in Calgary included Nessie as one of a suite of play objects (Figure 4) that allow visually-challenged children to explore an acoustic landscape as they move about the interactive outdoor classroom (Fabbri 2008; CTV Calgary 2010). We have observed how Nessie's combination of water, sound, and Braille provides visually-impaired children with another way to learn through play and explore sensory information.

Figure 4. Nessie at the CNIB Outdoor Classroom

Figure 5a. Tactile map of the CNIB's Outdoor Classroom
Figure 5b. A close-up of a child interacting with Nessie's representation on the tactile map



The CNIB Outdoor Classroom project represented the first opportunity to bring Nessie to children with disabilities. Subsequently we brought Nessie to Ryerson's Early Learning Centre where all children, including those with disabilities, had the opportunity to play with and explore Nessie's potential. Anecdotal comments from

educators and parents along with our observations of children's engagement and pleasure has encouraged us to include Nessie in the Sensory Play Studio research project under development at the EDGE Lab.

Hydraulophones and Informal Learning

We recognize that children engaging in open-ended, non-purposive play with sensory objects are participating in the same cyclical process of theory-building, theory-testing, and reflecting that scientists use to explore the world around them (Chaillé and Britain 2003). The importance of children feeling good about exploring, and having fun during what would often be considered "messy" and "noisy" play, highlights the need children have for autonomous and transgressive challenges to parental order, within a supportive social context (King 2007; Nolan, Raynes-Goldie and McBride 2011).

Play-based learning and exploration, involving various learning domains including fine/gross motor skills and spatial, social, auditory, and melodic aspects, incorporates all aspects of Howard Gardner called "multiple intelligences" (musical, bodily kinesthetic, inter and intrapersonal intelligences, logico-mathematical), and is not restricted to the exploration of musical learning (Gardner and Hatch 1989). Much of the work done at our lab focuses on supporting children with disabilities through research, inquiry, and the creation of tools, technologies, and learning opportunities centered in sensory play and engagement with the physical world. As an interactive learning object, Nessie is positioned at the center of a number of theories about children and learning. Nessie was inspired by Mann's work at MIT where he explores constructionism and computer-mediated reality (Mann 2007; Mann and Niedzviecki 2001). In some ways, the hydraulophone is similar to soundbeam[4] technologies, which can be used with small children in both creative and therapeutic contexts. However, the hydraulophone is intended to be a play tool that is more open-ended and exploratory in terms of where and how it can be used by children. Nessie is a water fountain that functions as a tangible play object in unstructured and informal learning environments such as parks and play areas, where interactions are child-initiated, playful, and frolicking, and where exploration and theory-building is decidedly of secondary importance from a child's perspective.

The play-based music-making that can occur during free exploration of Nessie is well aligned with the Reggio Emilia and inclusive play approaches that inform the practices and pedagogy in many Early Learning Centres (Pope Edwards 2002). The intersection of musical expression and multi-sensory exploration provides a rich opportunity for learning about music, mathematics, social intelligence, and other literacies. These pedagogical approaches focus on building relationships between learners and teachers, extending meaning-making through creative play and free expression. Mann's research focuses on creating new tools that encourage children to explore their senses in unstructured play; the tools are intended to infuse pleasure and play into inquiry, theory-building, and the co-construction of knowledge, and to nurture the sense of engagement and wonder that is the foundation of scientific exploration.

[4] See http://www.soundbeam.co.uk/special-needs-music-therapy/references.html

As adults, our understanding and motivations for play become purposive and this often guides our approaches to the curriculum and pedagogy of play we devise for children. Play as a component of curriculum is tied to outcomes, benchmarks, and rubrics for evaluation. This kind of structured organization of school activities prepares young children to engage with the various disciplines that will be required throughout their school careers. However, many educators are now exploring a more transdisciplinary approach to engage children in meaningful play-based learning and inquiry that leverages experiences across various domains and activities (Nolan and Bakan 2010) within the child's world.

Future Directions for Collaboration

Researchers at the EDGE Lab are interested in technologies that support sensory play and children with disabilities, particularly technologies involving touch and sound. Pilot inquiries into more inclusive notions of sensory immersion in digital games, as well as the impact of Snoezelen[5] sensory therapy technologies, are informing the development of a sensory play space that will include opportunities for early childhood educators to work with learning, play, and technology researchers to experiment with Nessie in various configurations. For example, a small study is currently underway at two early learning environments that include children with special needs; this is an adjunct to an ongoing research project called “Voices of Digital Natives,” which is exploring how hydraulophone technology can support social communication for children with sensory integration disorders such as autism. This project has been investigating how children communicate with each other about their experiences and knowledge of using various (largely digital) technologies. Another research focus will be integrating our observations of Nessie in informal learning environments into the creation of new sensory play technologies and practices. We believe this work has the potential to extend the sensory play experience from water and sound to include the other senses, as the foundation for our sensory play studio at the EDGE Lab.

We seek to engage children in non-purposive play, situated in a child’s choice and desire for open-ended exploration predicated on their own goals and interests. Nessie takes sensory play to the playground, away from formal schooling, learning, or institutional settings. It represents an awareness of how to better support children's right to inclusive, autonomous, sensory and pleasurable exploration and construction of new knowledge.

Conclusion

The serendipitous intersection of interests that led to our collaboration has opened our eyes to what exists in the design and engineering community that can be of great interest and benefit to researchers of children in the early years and of course children themselves. Instead of looking to catalogues of materials designed and marketed to schools, educators and educational researchers should look to the community. We need to see what is happening around us. Mann, who developed Nessie with his daughters in mind, took the initiative to share his ideas with early

[5] See http://www.snoezeleninfo.com/

years educators who realized the values of Nessie as a therapeutic and learning tool. The dynamic and evolving "maker culture" movement (Bal, Nolan and Seko (in press)), fostered by the growing availability of tools and technologies and hacking communities, is initiating a renaissance of the home inventor. Online communities such as Instructables[6] and publications like *Make Magazine*[7] are rife with ideas and innovations waiting for educators who are looking for creative solutions to problems in the classroom that cannot be solved through existing institutional channels.

Acknowledgements

The Experiential Design and Gaming Environments (EDGE) lab acknowledges the support of the Canadian Foundation for Innovation, the Ontario Ministry of Research and Innovation, and Ryerson University. The authors would also like to thank Melanie McBride and Alison Gaston for their assistance with this paper.

Jason Nolan *is director of the Experiential Design and Gaming Environment (EDGE) lab, a professor in early childhood studies at Ryerson University, and a member of the Ryerson/York graduate program in Communication and Culture. Jason graduated with a Ph.D. in critical pedagogy from the Ontario Institute for Studies in Education in 2001. His research focuses on adaptive design for children with disabilities, gaming/play, privacy/autonomy, sensory play, and informal learning environments. His work has appeared in journals such as* Canadian Children, New Media & Society, Surveillance and Society, *and* Jeunesse. *He is co-editor of* The International Handbook of Virtual Learning Environments.

Steve Mann *received his Ph.D. degree from MIT in 1997. He is a professor at University of Toronto in the Faculty of Applied Science. He is an inventor who has been featured by numerous news organizations including AP News,* The New York Times, The LA Times, Time, Newsweek, Fortune, WiReD, *NBC, ABC, CNN, CBC, CBS, Reuters, and* New Scientist. *Mann has written more than 200 publications. His work has been shown in numerous galleries and museums, including the Smithsonian Institute, National Museum of American History, The Science Museum, Museum of Modern Art (New York), Stedelijk Museum (Amsterdam), Triennale di Milano, and San Francisco Art Institute.*

Danny Bakan *is a doctoral student in music education at the University of British Columbia as well as a songwriter and performing artist. Danny holds a Master's degree in Curriculum, Teaching and Learning from the Ontario Institute for Studies in Education at the University of Toronto and is interested in arts-based research and a/r/tographic methodologies. His portfolio includes two albums, performances across North America, and appearances on CBC and NPR. Danny has taught music and creative arts in school and non-school settings for 20 years including Ryerson University's Early Childhood Studies program and the Royal Conservatory of Music in Toronto.*

[6] http://www.instructables.com/
[7] http://makezine.com/

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