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## The Future in their Imaginations: Music and Robotics School Holidays Program for School-Aged Children

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### Abstract

This report reflects on an exploratory STEAM workshop at the University of Newcastle, School of Creative Industries, Conservatorium of Music, Australia. Twenty-six middle school-aged students attended the two-day workshop. On the final day, students presented an immersive concert for parents and friends, showcasing creativity, innovation and teamwork. Interestingly, Lego robots were employed as a physical tool through which music-making students interacted with each other and built attributes of creative engagement. These attributes were measured via the Six C's established by Bers comprising: (1) Collaboration; (2) Community Building; (3) Communication; (4) Content Creation; (5) Creativity; and (6) Choices of Conduct. This report suggests the integration of robots can also enrich the musicianship of students, building upon their traditional music training.

### Keywords

Music, robotics, collaboration, creativity, music education

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## **The Future in their Imaginations: Music and Robotics School Holidays Program for School-Aged Children**

*Adam Manning, Amelia Besseny & Helen J. English*

### **Music and Robotics Workshop Overview**

In this report we reflect on an exploratory two-day music and robotics workshop. The workshop involved twenty-six students from school years 4 – 8 (aged 9-14). It combined robotics and music as a STEAM endeavour and demonstrated the links between music and engineering-thinking, with reference to Bers Six C's.

### **Music and Robotics Learning Approach**

Within the two workshop days, students formed four small collaborative groups with an assigned tutor. Each group had access to a creative tool kit, their own creative lab and rehearsal space. The creative tool kits included:

1. Spheros and an iPad to operate (one per two students)
2. Lego Mindstorms with extra pieces to create customised instrument-playing limbs (one per group of two students)
3. Percussion Instruments (including xylophone, glockenspiel, drums and shakers)

Students were encouraged to bring their own instruments if they had them. Rooms were equipped with desktop computers, music software and midi keyboards.

## **Day One**

On day one, students were briefed on the components of their creative tool kits. This included learning the basic components of building and coding Lego Mindstorm robots, driving Spheros, making their robot dance to a BPM and discussions about how they could actively collaborate with their robots as a musical performer. Students then moved to their collaborative groups to experiment with their toolkit items. At the end of each session, students shared their learning outcomes with their peers.



*Figure 1 Music and Coding final performance based on a narrative of Mars NASA theme*

## **Day Two**

Day two began with the formation of two large groups. The first group coded Spheros and the second group developed musical material. The Spheros group created code-based movements to create the narrative of NASA's Mars mission for the final performance. The music-making group explored improvisation techniques to support the performance narrative.

At the end of the second day, all groups rehearsed together in the Conservatorium concert hall in preparation for the evening's performance, considering stage placement, lighting, and movement. Furthermore, staff selected an overall concert theme to provide a loose structure that was broad enough to allow student's own ideas and inclusive rather than in a challenge format (Rusk et al., 2008). The over-arching Mars narrative and "quest" towards the final performance put experience, risk taking and forward-motion at the forefront of the learning activities (Lavers & Leroux, 2018, p.127). The final performance showcased the skills refined during the workshop to an enthusiastic audience of friends and family (Figure 2).



*Figure 2 Music and Coding final performance based on a narrative of Mars NASA theme.*



*Figure 3 Music and Coding final performance based on a narrative of Mars NASA theme.*

### **The Six C's of Engagement**

In a children's robotics workshop, not dissimilar from our own, Sullivan and Bers (2018) apply the Positive Technological Development (PTD) framework to their work, using a guiding concept of the Six C's. The checklist was formulated by Bers in 2012 and the Six C's include, (1) Collaboration; (2) Community Building; (3) Communication; (4) Content Creation; (5) Creativity; and (6) Choices of Conduct. In reflecting on our workshops, we applied the checklist, observing that students were deeply engaged in the creation and musical capabilities of their robots. They also collaborated effectively towards a shared goal of a musical performance, demonstrating openness and respect towards the sharing of ideas and individual talents (Table 1).

Table 1

Examples of the Six C's in the Music and Robotics Workshop

<b>Six Cs (Bers, 2012)</b>	<b>Sullivan and Bers (2018) Example Behaviours</b>	<b>Observations from our workshop (2019)</b>
<b>Collaboration</b>	Students borrow or lend materials. <sup>[L]</sup> <sub>[SEP]</sub> Students help each other understand materials	Students worked in breakout pairs to build their robots together. Students shared kits and code amongst their peers.
<b>Community Building</b>	Students volunteer to share work with others. Students create projects to solve a social, community, or classroom problem	In discussion and 'show and tell', students shared their progress toward the concert material and celebrated the creativity of group members.
<b>Communication</b>	Students exchange ideas with others. Students seek help and ask questions	Students sought help from both teachers and peers to troubleshoot code or optimise robots' limbs for instrument-playing.
<b>Content Creation</b>	Students create a functional program for their robot. Students debug problems in their program	Students made their robot dance in time with a BPM. They coordinated driving Spheros and created instrument-playing robots that hit percussion in time with a live musical ensemble.
<b>Creativity</b>	Students use a variety of materials for their projects (arts, crafts, technical materials such as sensors, etc.) Students use technology in unexpected or unconventional ways.	Students combined Mindstorm kits, Spheros, live instrumentation, body percussion, narration and live performance techniques to create an immersive concert. Students extended their brief, creating their own soundtrack for their dancing robot.
<b>Choices of Conduct</b>	Students are following classroom rules. Students are using materials responsibly	Students felt a sense of pride around their creations and respected the creations of their peers.

## **Conclusions**

Whilst the Music and Robotics workshop is still being refined, the level of engagement by students and their ability to collaborate with each other and their robots in musical ways, made the endeavour a success. Furthermore, one could suggest, the positive student engagement was due a strong sense of ownership that came from being fully involved in designing and creating the robots and performance. Highlights from the 2019 Music and Robotics workshop can be viewed here:

<https://www.facebook.com/NewcastleConservatoriumOfMusic/videos/427169331559437/>

<https://www.facebook.com/NewcastleConservatoriumOfMusic/videos/2514538932168664/>

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