

**Title:** *Inclusive Digital Maker Futures for Children via Physical Computing*

This workshop will bring together researchers and educators to imagine a future of low-cost, widely-available digital making for children, both within the STEAM classroom and beyond. In particular, we are interested in expanding the reach of digital making *with programmable microcontrollers* (such as Arduino, the BBC micro:bit, etc.) to underrepresented children in the STEAM fields, which includes historically excluded or marginalized children as well as those lacking access to computers and/or the Internet. Participants will report on their experience helping children learn about digital technology while creating wearables, robotics, environmental sensors and more. Participants who submit a position paper or work-in-progress report will have an opportunity to present their work and ideas. From these presentations, we will select emerging themes to discuss.

### **Goals and Outcomes**

The goals of the workshop are to:

- to facilitate discussions about inclusive digital making for children using programmable micro-controllers;
- to explore the benefits and challenges of inclusive digital making;
- to discuss open questions and future directions for the field

The workshop outcome will be a vision statement about the future of digital maker technologies, with particular consideration given to the needs of a diverse set of children. We will also document a collection of inclusive educational resources for widely available programmable micro-controllers such as the BBC micro:bit and Arduino. We hope these will inspire a new population of educators and students from around the globe to engage with STEAM subjects. Workshop participants will come away with new knowledge and experience to drive their own efforts in inclusive digital making.

### **Format and Program Structure**

This is **full day** workshop that include hands-on activities with the BBC micro:bit and MicroCode, lightning talks on experiences teaching with programmable micro-controllers and new research directions, as well as group discussions on ways to address the digital divide in STEAM.

The workshop will provide opportunities for participants to work hands-on with **MicroCode**, an experience that combines the micro:bit V2 with a display accessory to enable live and portable programming *without the need for a separate computer* (<https://aka.ms/microcode>). The MicroCode project is open source (<https://github.com/microsoft/microcode>) and available for people to build on. Hardware will be made available during the workshop. Familiarity with programmable micro-controllers is helpful, but not required.

We will make all the papers available via the web before the workshop and use them to organize presentations and discussions.

09:00-09:30	Overview of micro:bit and related digital maker technologies
09:30-10:15	Hands on activities with MicroCode
10:15-10:45	<i>Break</i>
10:45-12:15	Presentations/discussions about inclusive digital making including with younger and more diverse audiences
12:15-13:15	<i>Lunch</i>
13:15-14:45	Presentations/discussions on digital making outside of the classroom
14:45-15:15	<i>Break</i>
15:15-16:45	Presentations/discussions about digital making outside of CS education
16:45-17:30	Synthesis and collation of key ideas into vision statement, wrap-up and next steps

## Participation

Everyone who wishes to participate should submit one of the following: (1) a statement of interest (a few paragraphs via email to the workshop chair, Tom Ball), (2) position paper, or (3) work-in-progress report (see below for more detail). Participation in this workshop does *not* require the submission of a paper; however, participants are encouraged to submit a brief statement describing their interest and motivation in joining the workshop. Those who wish to present must submit either a position paper or work-in-progress report.

## Submission and Deadlines: Lightning Talks

We welcome paper submissions of *position papers*, *work-in-progress reports* for a lightning talk, related to inclusive digital making for children:

- **position papers** including but not limited to discussing research questions, methodology, opportunities, benefits, challenges, or implications of inclusive digital making for children;
- **work-in progress reports** including but not limited to preliminary results, demonstrations, case studies, or surveys that highlight current research in inclusive digital making for children.

Paper length is limited to 4 pages maximum, including references. The selection will be based on the relevance and quality of the papers submitted. Accepted papers will be invited to present their submission in a dedicated lightning talk session. At least one author of each accepted paper must register and attend the workshop and main conference. Submissions should be in single column PDF format, following the ACM SIGCHI Paper Format. Templates are available for Word and Overleaf.

Submissions should *not* be anonymized.

- Submit your paper via EasyChair
- **Deadline:** April 15, 2024
- **Decision Notification:** May 1, 2024

## Workshop Organizers

The organizers include founding members of the core technical team that developed the BBC micro:bit programming environment, firmware, and hardware, experts on microcontroller-based hardware+software systems, CS and STEAM education and user-experience.

- 53 • **Thomas Ball (main contact:** [tball@microsoft.com](mailto:tball@microsoft.com)), Partner Researcher, Microsoft (<https://www.microsoft.com/en-us/research/people/tball/>). Tom led the team that developed the MakeCode programming environment  
54 for the BBC micro:bit, and was a founding member of the original BBC micro:bit deployment in the UK in 2015.  
55 His expertise is in software engineering, programming languages, and platforms for CS education. His current  
56 focus is on bringing the BBC micro:bit to remote/rural communities.  
57
- 58 • **Jayne Everson**, Ph.D. student, University of Washington, <https://jayneeverson.com/resume>. Jayne studies  
59 implicit power structures in CS classrooms. Her work is informed by her experience as a classroom teacher in  
60 math, science, engineering, as well as with robotics and makerspaces.  
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- 62 • **Joe Finney**, Professor, Lancaster University (<https://www.lancaster.ac.uk/scc/about-us/people/joe-finney>). As a  
63 founding member of the original BBC micro:bit deployment, Joe architected and continues to maintain the C++  
64 CODAL runtime and firmware that forms the foundation of the micro:bit software stack. His research focuses  
65 on democratizing access to embedded tools and technologies to empower others to create new applications and  
66 devices that bring positive impacts on society.  
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- 68 • **Steve Hodges**, Professor, Lancaster University (<https://aka.ms/shodges/>). Steve guided hardware development  
69 and manufacturing during the original BBC micro:bit deployment, and continues to advise the MEF in parallel  
70 with pursuing research into physical computing and interactive devices. Steve's career goal is to identify, develop  
71 and deliver hardware-plus-software experiences that provide lasting value to users and society, and to inspire  
72 and empower future generations of creative technologists to do the same.  
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- 74 • **Elisa Rubegni**, Associate Professor, Lancaster University. (<https://www.lancaster.ac.uk/scc/about-us/people/elisa-rubegni>). Elisa's research focuses on designing and evaluating children's experience in interacting with  
75 mobile and distributed technologies, and the social agency this creates in educational contexts. Her projects  
76 aimed at investigating research questions around the impact of technology-based experiences for supporting  
77 children's narrative thinking, emotional and cognitive skills development.  
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- 79 • **R. Benjamin Shapiro**, Associate Professor, University of Washington (<https://benshapi.ro/>). Ben is a learning  
80 scientist and a champion of the BBC micro:bit since its early days. He designs new learning technologies  
81 and experiences that enable people, especially youth, to make new computational systems that help them to  
82 understand the world around themselves, express themselves creatively, and care for human and non-human  
83 others.  
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- 85 • **Colby Tofel-Grehl**, Associate Professor, Utah State University (<https://cehs.usu.edu/teal/directory/tofel-grehl-colby>). Colby designs teacher professional development and curricular materials within frameworks of rightful  
86 presence and critical theories to facilitate minoritized rural youth's success within STEM spaces. Her scholarship  
87 interrogates the structures, systems, and practices that foster inequities across STEM learning environments.  
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- 89 • **Lorraine Underwood**, Senior Teaching Associate and PhD student, Lancaster University, (<https://www.lancaster.ac.uk/scc/about-us/people/lorraine-underwood>). Lorraine's research is around using physical computing to teach data science to primary aged children of ages 5 to 11. She has developed both hardware and  
90 software tools around the micro:bit to achieve this goal. Lorraine has very recently run classroom studies with  
91 the micro:bit and MicroCode.  
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- 93 • **Rojin Vishkaie**, Senior User Experience Researcher at Amazon (<https://www.linkedin.com/in/rojin-vishkaie-ph-d-3755b834/>). Rojin is an expert in contextual and participatory design, user-experience and user-centered  
94 design; she performs research via ethnographic methods and usability testing. Her work focuses on design and  
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105 evaluation of technology, with recent use cases in devices, mixed-reality education, museums, and children's  
106 gaming and toys.  
107 • **Kimberly Ying**, Software Engineer on MakeCode team, Microsoft. <https://www.linkedin.com/in/kimberlymying/>.  
108 Kim is a front-end developer for MakeCode, working full time on the team for about two years. She holds a  
109 Ph.D. in Human-Centered Computing from the University of Florida. Her passions lie at the intersection of  
110 computer science education and equity for all.  
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### 113 **Contact**

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