Code, Create, Collaborate: Co-Construct Physical Stories

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Abstract

This workshop presents an innovative approach to programming education, integrating storytelling, physical computing (micro:bit), and teamwork into a cohesive learning experience. Participants receive modular skill cards that serve as a flexible scaffolding, facilitating self-directed projects under a shared theme. This pedagogical strategy has been shown to promote creativity, collaboration, and peer-to-peer learning, while concurrently enhancing the appeal and accessibility of computer science education, particularly for novices and underrepresented groups such as girls. The workshop is grounded in the principles of constructionist and maker education, integrating block-based coding with tangible creation and storytelling to foster a motivating and inclusive environment for learners. Participants collaborate in teams to design unique projects, utilizing skill cards as a resource for guidance, examples, and support. The storytelling component encourages participants to contribute to a shared theme (e.g., a zoo) while pursuing individual goals, fostering ownership and engagement. The adaptable card system caters to diverse learning needs, promoting group interaction and peer support prior to teacher intervention. The efficacy of this format has been demonstrated through its successful implementation with teachers and students, highlighting its potential to enhance coding skills, motivation, and equity in STEM education. The workshop's integration of technical skills with creativity and collaboration establishes a scalable model for inclusive and engaging computer science education that resonates with learners from diverse backgrounds.

Tools, Skills and Materials: Tools -> micro:bit, Skills -> Programming, Skills -> Teamwork

Keywords and Phrases: Constructionist Learning, Maker Education, Physical Computing, Computer Science Education

Scope, Motivation, and Background

Learning to program digital devices is often perceived as difficult, boring and nerdy, especially by girls. Block-based languages such as Scratch or MakeCode for micro:bit can be more appealing to beginners or underrepresented groups such as girls (Zdawczyk & Varma, 2023). Even in a beginner's class, heterogeneous prior knowledge and progress curves are to be expected. Project based learning (Yuan & Bowen, 2018) and tangible creation (Papert, 1980) have the potential to foster sensemaking, stimulate interest and learning. We argue that storytelling can help facilitate motivation

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and acceptance of a programming project. However, not all stories resonate with all students, and one-size-fits-all approaches tend to be unsuitable for all. Therefore, we have developed a format to scaffold programming in school settings by combining adaptive analog learning materials with an inclusive but open storytelling aspect. We are using micro:bits as the base platform because it's comparably easy to learn, inexpensive, and offer tremendous possibilities for learners of all ages. The learning materials consist of different skill cards originally inspired the Scratch coding cards (Scratch - Ideas, 2025), our previous (Zurich University of Teacher Education, 2019), as well as Schmalfeldt's work (2019). Initially, the cards presented challenges to be solved, displaying solutions on the back. However, the challenge aspect has subsequently been removed, as the objective is to facilitate rather than to pose challenges. Each card features a short explanation with code example on the front and, in the case of an external part, a wiring diagram, and more detailed information on the back. There are easier cards such as how to integrate a button, display text on the pixel matrix or play sounds. More advanced cards help with the usage of external sensors (e.g. range sensors) and actors (e.g. 7-segment displays or servo and dc motors) or more advanced coding concepts (e.g. messaging or functions).

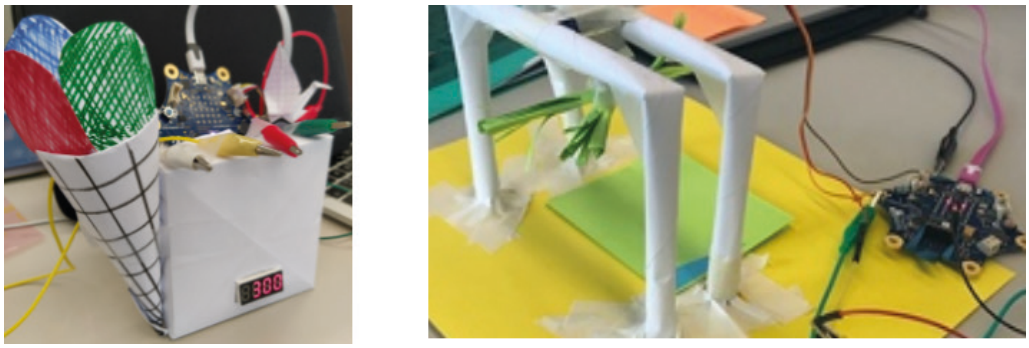

Figure 1: Two projects: ice cream stand with sales counter and elephant washing machine (using Calliope mini, a german fork of micro:bit technology)

The storytelling part of the workshop consists of a broad general theme (e.g., a zoo) that the whole workshop group should accomplish, but leaves enough freedom for individual teams to decide which part (cf. Figure 1 for two examples) they want to work on. Enabling teams to select their own goals and engage in their own distinctive endeavors has the potential to significantly boost their motivation levels. This empowerment fosters a sense of ownership over their projects, likely leading to an increased inclination to achieve these self-imposed objectives. This creates even more learning opportunities for others as there is more to discover in group exchanges than in a one-for-all task environment. The modular card support system allows teams to build the support they need by selecting the appropriate cards. If help is needed to fill in the gaps between cards, students are encouraged to support each other before seeking teacher support, fostering group interactions and honing skills. We have used the format with thousands of teachers in training courses at the Zurich University of Teacher Education and students with CYBATHLON ETH Zurich (Schifferle & Kollegger, 2024).

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