Connecting primary-aged children to place through teaching data science with physical computing tools

Future Places Centre | Lancaster University

micro:bit

Emergence of new technical areas and tools provide new opportunities around data science, environmental education and climate change. Our goal is to:

- Create simple, ethical tools to introduce data science in schools.
- Connect children to place using data and technology.
- Support development of data science and data literacy skills across the curriculum in primary school.
- Support teachers with varying confidence and experience of using technologies.

Ultimately leading to technologies that support longitudinal, place-based environmental education to enable children to take action and monitor change.

Clip:bit

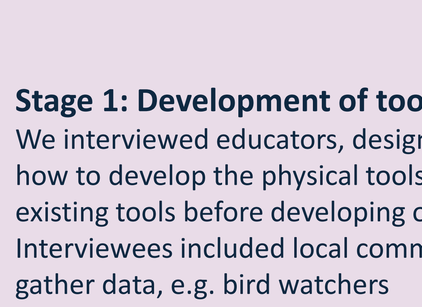
The clip:bit is a micro:bit accessory for collecting data outdoors. It has 14 buttons, LEDs and two 7-segment displays.

Classification

To prepare for data collection, the children sketch and classify the items they are collecting. Drawing their own images helps them learn to recognise the item and identify key features. It gives students agency over the data they are collecting.

Coding

Children write the code in a block-based language that runs on the tools. Teachers can teach cross curricular skills like coding alongside the main topic. This demonstrates how digital skills are embedded into real world s



Visualisation

In the Cloudlet, children can create graphs and charts using their data.
This creates learning opportunities in the maths curriculum.

Digital twins

Their drawings are used to create digital twins of the data. This can further learning around habitats and seasonal shifts.

Place based data

Data recorded using a GPS add-on can be visualised using maps.

Sharing

These images can be saved and added to learning journals or projected to the wider school audience.

Prepare → **Collect** → **Analyse** → **Share** → **Prepare**

Outdoor data collection

Children use the clip:bit they've prepared to collect data outdoors. The clip:bits are battery powered, lightweight and water resistant.

Collaborative learning

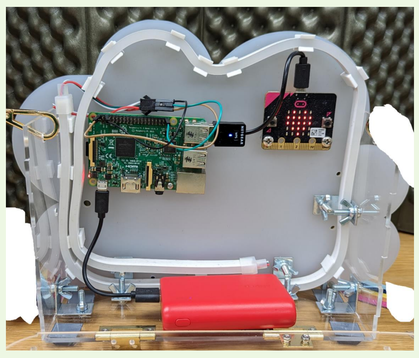
The children work collaboratively to identify the objects and to record them. There are enough objects for the students to share in the identification.

Real world use

The children are using a tool that they have coded in a real world scenario. They understand how it works because they coded it. There are no black boxes here.

Useful technology

The data is stored in the persistent memory of the micro:bit.



Classroom Cloudlet

The Classroom Cloudlet is a tangible data storage device. All of the data from the clip:bits can be uploaded here. The cloudlet lights up as this data arrives to signify the data transfer. This creates discussions around data ownership and privacy.

Browsing the data

The students can connect to the Cloudlet and browse their data on a web page. They can sort and filter their data as well as the data of their peers.

Creating connections

Seeing their own images on the website in the cloudlet creates a connection to the data for the children. They remember collecting the data, they trust that the technology saved and stored their data accurately.

Methods

We worked with groups of adults, educators and over 130 children in the North West of the UK to research how our tools could be used to teach and promote data science.

Stage 1: Development of tools

We interviewed educators, designers and computer scientists on how to develop the physical tools. We looked at adapting existing tools before developing our own.
Interviewees included local community groups that typically gather data, e.g. bird watchers

Stage 2: Use of tools in the classroom

We worked with a range of age groups in different schools to determine how the tools could be used in the classroom, both by educators and children.

Stage 3: Use of the tools outdoors

We facilitated three outdoor trips to Morecambe Bay and Brockhole at Lake Windermere in Cumbria to see how children held and used the tools outdoors in the wild.

Stage 4: A teacher's use of the tools

The final piece of research was giving the tools to a teacher to see how they would use them in their classroom, their lessons with their students. What areas of the curriculum would they teach using these tools?

Teacher Evaluation Outcomes

Engagement and focus

"…they wouldn't have stayed focused like that in a normal maths lesson…I think because it was their data, their information."

Purposeful education and justification of outdoor learning

"You're giving them a piece of technology that has a massive purpose. It has. You could do something incredibly useful with this."
"I think actually getting them outside, getting them looking at nature…paying attention to what's out there to what they walk past and ignore."

Cross curricular benefits

"Where it really frustrates me as a teacher that we're being told to go back to teaching standalone subjects. Where actually they're not standalone subjects. They all overlap."

Broadening perceptions and experience of computing

"…they're suddenly seeing coding on something different, a different way of coding. It's coding for a purpose rather than just making something move on a screen."

Ownership of data

"In a math's lesson you're just using the printed data on the sheet that's been given to you. That means nothing. They don't have any questions about (it)."

Future Work

Making the process cyclic

- Students create action based on the data
- Students collect and analyse the data again
- Determine if action made an impact

Create physical data outputs

- Represent the data they have collected using physical computing.
- Make tangible interactive structures of data

Expand to secondary school

- Look at connecting the tools to Maths, Geography and Computing lessons in secondary schools
- Expose more complex aspects, coding, data analysis for these older children

Add more data collection tools

- Adapt the tools to easily add more sensors, for example soil sensors, temperature, etc.
- Adapt the analysis tools to combine different data together

Commercialise/simplify the tools

- Make the clip:bit for sale
- Adapt the clip:bit to make it easy to build
- Create new tools both hardware and software to make it easy for schools to use the micro:bit for data collection and analysis

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