Micro:Vote: An Introduction to Python using the BBC micro:bit

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Course CS0

Programming Language Python, Other

Resource Type Project

CS Concepts • Data Types, Identifiers and associated concepts, Expressions, Operators and I/O statements, Control Structures and Control Flow

Knowledge Unit Programming Concepts

SYNOPSIS

The Micro:Vote project is designed as an introduction to text-based programming through a 12-week project aimed at 11 to 13 year olds. The project is designed as a School-University partnership whose aim is to highlight the role of creativity and social impact in computing through the design of digital voting posters using the BBC micro:bit and MicroPython.
Adopting a Design Studio approach, the project scaffolds students in the creation of a physical computing voting system and informative poster, to gather responses on an issue of social importance within the community. Through the lens of Human-Computer Interaction, students investigate the role of computing in activism and learn to implement data and control structures.

ACM Reference Format:

Megan Venn-Wycherley and Christine Bennett. 2022. Micro:Vote: An Introduction to Python using the BBC micro:bit. In EngageCSEdu. March 2022. 2 pages. https://doi.org/10.1145/3519937

KEYWORDS

Computing education, physical computing, secondary school, K-12 education, micro:bit, design studio, school-university partnerships

1 ENGAGEMENT HIGHLIGHTS

The pedagogy of the Micro:Vote project is adapted from the Human-Computer Interaction (HCI) Design Studio approach for Higher Education computing students [1,2]. This reports an improvement in student engagement with computing concepts due the creative and practical application of theoretical concepts, improving behaviour and confidence [1,4]. The divergent application of a unified codebase allows for creative student exploration, while minimising teacher workload, providing a balance in creativity and support. This project adapts the HCI Design Studio pedagogy, and is structured to include: 1) a design brief challenge for the students, requiring the creation of a simple micro:bit voting system and associated poster, 2) a desk 'crit' for instructors and peer feedback on projects, 3) a design review for instructors to provide formal feedback, and 4) a presentation, in which students can present the outcomes of their work. 5) A portfolio is kept by students throughout the process to evidence the evolution of their learning.

2 RECOMMENDATIONS

2.1 Pre-requisites

This project is aimed at 10-13 year olds who have an introductory understanding of programming and are looking to transition and extend this knowledge to a text-based environment. This project requires a minimum of one micro:bit between two students.

2.2 Time Considerations

This project is planned to run for 12 consecutive computing lessons, at approximately 45-60 minutes per session. To address the challenge of interruption or disruption to this schedule, the lessons follow a 'critical path' in which certain lessons are highlighted as critical to ensure completion of the project. There are 10 further lessons positioned as extension tasks if needed.

2.3 Challenge Commissioners

The project is the product of a school-university partnership, with a university acting as the challenge commissioner [3], which is reflected in the learning materials.

However, the role of commissioner can be played by any stakeholder involved in computing or activism to provide student access to role models, new experiences, and the development of their identity as 'computer scientists'. We recognize that this level of community engagement requires organization that is not always feasible within the school environment. The challenge commissioners do not have to be external parties, and we encourage instructors to explore internal stakeholders (e.g. staff/student groups/clubs) as potential challenge commissioners for the voting poster projects.

2.4 Design Brief Topics

Within the Design Studio pedagogical structure, there are two main approaches in their application: 1) a domain-driven approach that presents students with a domain within which they explore their projects (e.g. "create a project to improve your learning environment") or 2) a project-driven approach, in which requirements structure the response (e.g. "create a digital voting poster on a topic of improvement in your learning environment"). A project-driven approach is recommended for students with less experience of independent learning.

/2022/March – 999211.13
https://doi.org/10.1145/3519937

We recommend topics be driven by the challenge commissioners, and previous examples include 'improving your learning environment' or 'methods for managing school lunch queues'.

2.5 Presentations

The presentation of projects can take a variety of formats, including: an exhibition, in-class presentations, a report, or a podcast. There must be some form of engagement or feedback from the challenge commissioners to 'make it real' for students.

2.6 Differentiation

The materials include a standalone tutorials which cover individual computing concepts in further detail. These provide an overview of the topic and a series of challenges for independent learners to complete.

2.7 Adaptation

While the current resources are based in MicroPython, instructors can convert the project materials to suit the needs of their learners (e.g. block-based programming languages). Furthermore, resources use British-context examples to explain concepts (e.g. tea-making to practice flowcharts in Lesson 4a), and instructors may want to adapt contextually-relevant examples for their own learners.

3 DEVELOPMENT OF RESOURCE

This project was co-developed between an HCI department of a university and three secondary schools in areas of socio-economic deprivation, with six Year 8 classes taking part in their evaluation. The challenge focused on the improvement of the school environment. Students created posters with micro:bits programmed to record responses. In the trial, students worked in pairs to program their systems and kept individual portfolios on their experience (this can also be undertaken as an individual coding project). One school chose to visit the university to present their ideas, another chose to write a report to the university, and the third chose to create a podcast to share their findings.

3.1 Instructor Feedback

One instructor noted how the creative focus of the project encouraged students who might not traditionally engage in computing, saying *"if [the project] had just been code without something they could colour, enjoy and make pretty, I don't think they would have been as engaged*." Another instructor reported how a group of students, who were disengaged in computing lessons, worked toward a poster for their school dance studio which would allow students to vote for their preferred day of use. This was a personal challenge for these pupils, who wanted more time to practice dance routines, but found that the dance studio was only supervised in rare circumstances, and proposed that the Micro:Vote could support them in making a case to the school to provide supervision for the room on specific school lunchtimes.

3.2 Student Feedback

One student reported enjoying being "*trusted to go off on their own and work*" to prepare for the presentation exhibition held at the university and that this level of trust helped them to feel more confident in the work they produced. When asked directly about their experiences on the project, pupils reported that the *project "stretched my mind and made me think*" and they "*learned to never give up*" when they encountered programming-related problems, demonstrating increased confidence, resilience and engagement.

4 MATERIALS

4.1 Instructor Resources

Overview and Lesson Plans: An overview document providing the structure of the overall project and lesson plans for each session, including both critical path and extension lessons.

Lesson Slides and Resources: A series of lesson slides and resources organized in chronological order which reflect the instructor lesson plans. These also include speaker's notes to support instructor understanding and delivery.

Tutorials: A set of independent learning tutorials, aimed to act as extension tasks, are also included in the instructor resources. These include step-by-step walkthroughs of programming concepts and coding challenges, and can be shared with students as necessary.

Code Scripts: Complete python scripts have also been included in a separate folder and are individually referenced in the Lesson Plan document.

4.2 Student Resources

Researcher's Workbook: The Researcher's Workbook acts as a digital repository of each student's work, which reflects the tasks outlined in the instructor's lesson plans and associated slides.

Researcher's Handbook: The Researcher's Handbook" acts as an informative document to which students can refer if they wanted further information or guidance on the topics they had covered in class. It is not an obligatory part of the project.

5 ACKNOWLEDGEMENTS

We would like to express our sincere thanks to all those who took part in the above research, particularly to the staff and pupils without whom this would not have been possible. This work was funded by EPSRC award EP/L016176/1 (Centre for Doctoral Training in Digital Civics.)

6 REFERENCES

1. Panayiotis Koutsabasis, Spyros Vosinakis, Modestos Stavrakis, and Panagiotis Kyriakoulakos. 2018. Teaching HCI with a studio approach. *Proceedings of the 22nd Pan-Hellenic Conference on Informatics - PCI '18*: 282–287. https://doi.org/10.1145/3291533.3291561

2. Yolanda Jacobs Reimer and Sarah A. Douglas. 2003. Teaching HCI Design With the Studio Approach. *Computer Science Education* 13, 3: 191–205. https://doi.org/10.1076/csed.13.3.191.14945

3. Megan Venn-Wycherley and A. Kharrufa. 2019. HOPE for Computing Education: Towards the Infrastructuring of Support for University-School Partnerships. *In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*: 1–13.

4. Megan Venn-Wycherley, Christine Bennett, and Ahmed Kharrufa. 2020. Design Studios for K-12 Computing Education. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (SIGCSE '20), 1227–1233. https://doi.org/10.1145/3328778.3366923