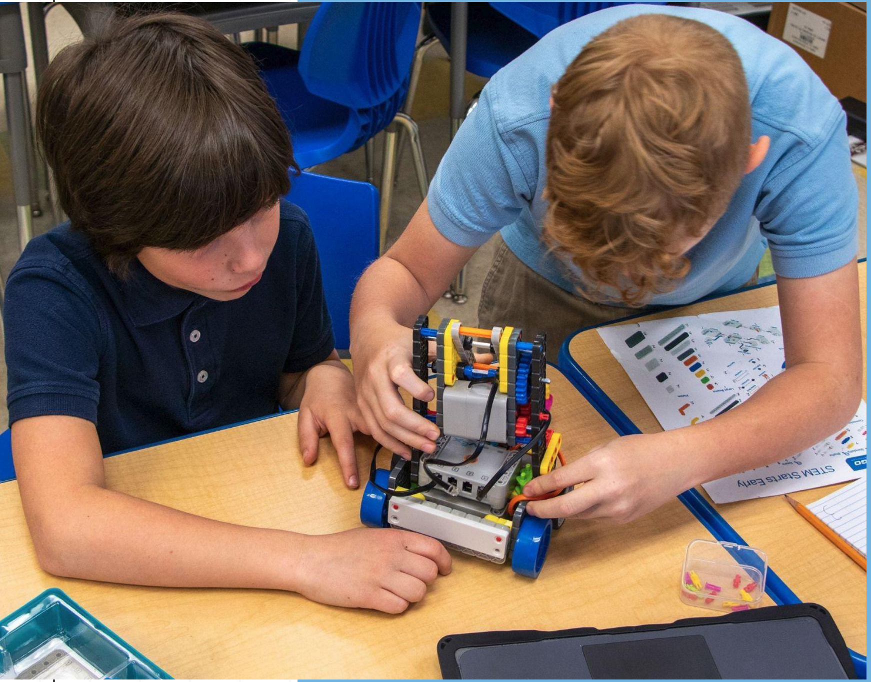


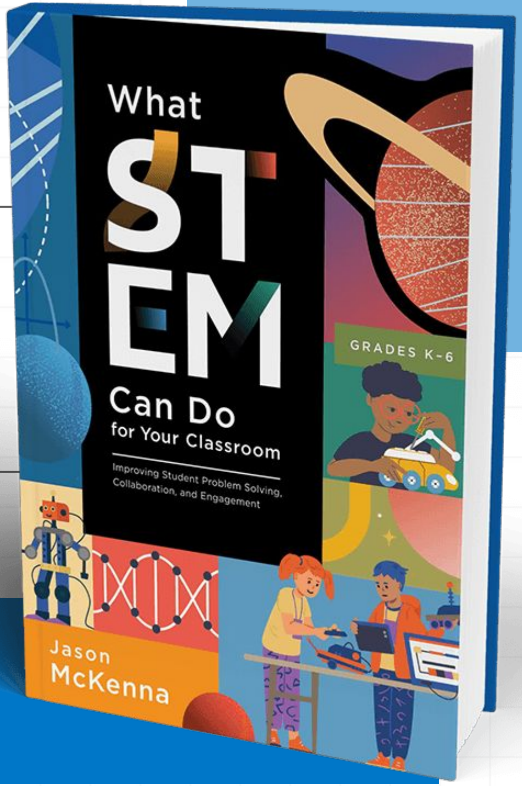
Best Practices to Reach all Learners In Our STEM Classrooms

Jason McKenna

Jason McKenna

VP of Global Educational Strategy,
VEX Robotics, Top 100 Education Influencers

What STEM Can Do for Your Classroom:
Improving Student Problem Solving, Collaboration, and Engagement



𝕏 @McKennaj72
jason@vex.com

DISTRICT ADMINISTRATION TOP 100 INFLUENCER

Accessibility is the Law

Nondiscrimination on the Basis of Disability; Accessibility of Web Information and Services of State and Local Government Entities (link)

- Implements a regulation based on Title II of Americans with Disabilities Act (ADA)
- Applies to state and local government entities including public schools
- Addresses web and mobile accessibility issues

Details

General. A public entity shall ensure that the following are readily accessible to and usable by individuals with disabilities:

(1) Web content that a public entity provides or makes available, directly or through contractual, licensing, or other arrangements; and

(2) Mobile apps that a public entity provides or makes available, directly or through contractual, licensing, or other arrangements.

Level of compliance: WCAG 2.1 AA

Dates of compliance:

Governmental entities larger than 50,000: April 24, 2026

Governmental entities smaller than 50,000: April 27, 2027

Section 508

In 1998, Congress amended the Rehabilitation Act of 1973 to require federal agencies to make their electronic and information technology (EIT) accessible to people with disabilities.

The law 29 U.S.C § 794d applies to all federal agencies when they develop, procure, maintain, or use electronic and information technology.

Section 508

Under Section 508, agencies must give disabled employees and members of the public access to information comparable to the access available to others.

Educational software is included under Section 508 guidelines.

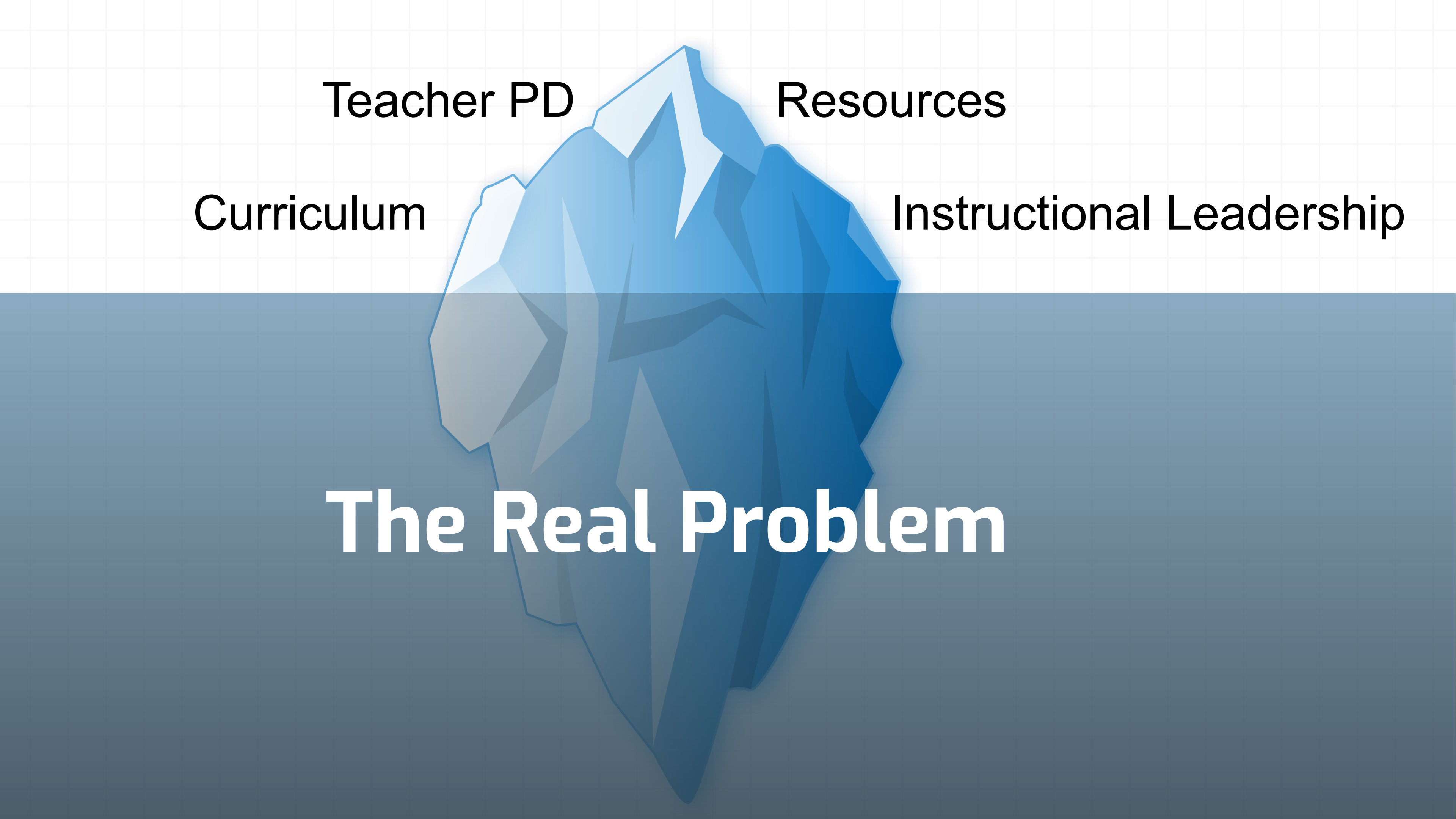
Several states have passed laws requiring 508 at the state level. California, Missouri, New York, Oklahoma, Washington.

When we prioritize accessibility, we create a better learning experience for every student.

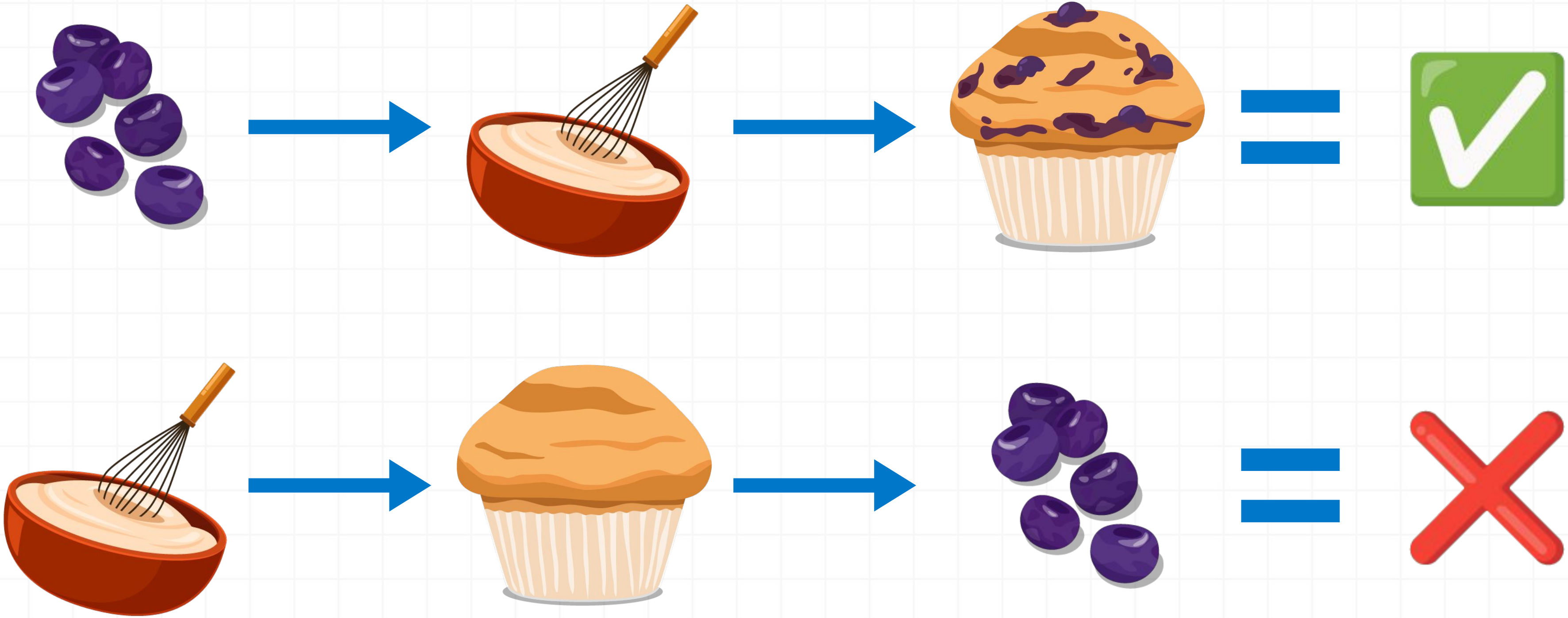
Examples

Voice-to-text messaging

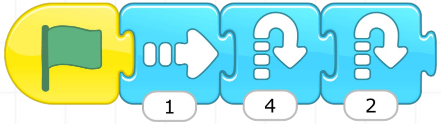
Originally designed for individuals with disabilities, is now widely used by millions for convenience.


Teacher PD
Resources
Curriculum
Instructional Leadership
The Real Problem

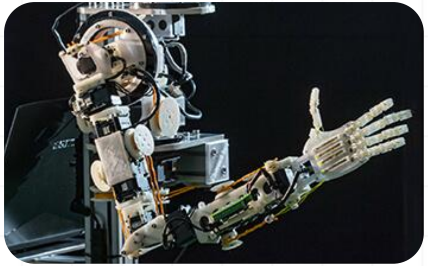
Blueberry Muffin

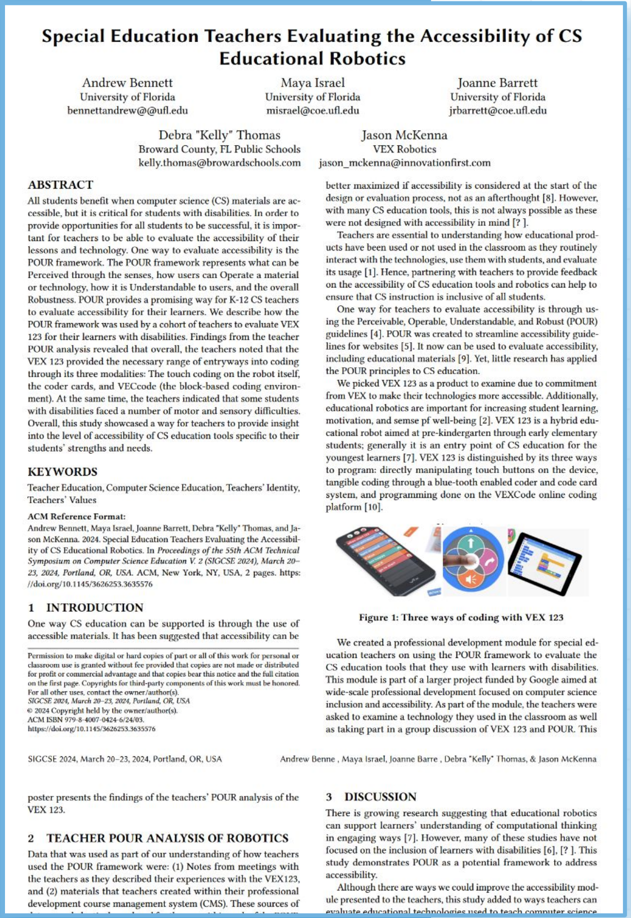


K 2nd 5th 8th 12th Carnegie Mellon University




```
public void squiral() {
    Turtle turtle = new Turtle();
    int dist = 0;
    while (dist < 100) {
        turtle.forward(dist);
        turtle.right(90);
        dist = dist + 10;
    }
    turtle.say("A Squiral!");
}
```





Special Education Teachers Evaluating the Accessibility of CS Educational Robotics

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ABSTRACT

All students benefit when computer science (CS) materials are accessible, but it is critical for students with disabilities. In order to provide opportunities for all students to be successful, it is important for teachers to be able to evaluate the accessibility of their lessons and technology. One way to evaluate accessibility is the POUR framework. The POUR framework represents what can be Perceived through the senses, how users can Operate a material or technology, how it is Understandable to users, and the overall Robustness. POUR provides a promising way for K-12 CS teachers to evaluate accessibility for their learners. We describe how the POUR framework was used by a cohort of teachers to evaluate VEX 123 for their learners with disabilities. Findings from the teacher POUR analysis revealed that overall, the teachers noted that the VEX 123 provided the necessary range of entryways into coding through its three modalities: The touch coding on the robot itself, the coder cards, and VECcode (the block-based coding environment). At the same time, the teachers indicated that some students with disabilities faced a number of motor and sensory difficulties. Overall, this study showcased a way for teachers to provide insight into the level of accessibility of CS education tools specific to their students' strengths and needs.

KEYWORDS

Teacher Education, Computer Science Education, Teachers' Identity, Teachers' Values

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1 INTRODUCTION

One way CS education can be supported is through the use of accessible materials. It has been suggested that accessibility can be better maximized if accessibility is considered at the start of the design or evaluation process, not as an afterthought [8]. However, with many CS education tools, this is not always possible as these were not designed with accessibility in mind [?].

Teachers are essential to understanding how educational products have been used or not used in the classroom as they routinely interact with the technologies, use them with students, and evaluate its usage [1]. Hence, partnering with teachers to provide feedback on the accessibility of CS education tools and robotics can help to ensure that CS instruction is inclusive of all students.

One way for teachers to evaluate accessibility is through using the Perceivable, Operable, Understandable, and Robust (POUR) guidelines [4]. POUR was created to streamline accessibility guidelines for websites [5]. It now can be used to evaluate accessibility, including educational materials [9]. Yet, little research has applied the POUR principles to CS education.

We picked VEX 123 as a product to examine due to commitment from VEX to make their technologies more accessible. Additionally, educational robotics are important for increasing student learning, motivation, and semse pf well-being [2]. VEX 123 is a hybrid educational robot aimed at pre-kindergarten through early elementary students; generally it is an entry point of CS education for the youngest learners [7]. VEX 123 is distinguished by its three ways to program: directly manipulating touch buttons on the device, tangible coding through a blue-tooth enabled coder and code card system, and programming done on the VEXCode online coding platform [10].

Figure 1: Three ways of coding with VEX 123

We created a professional development module for special education teachers on using the POUR framework to evaluate the CS education tools that they use with learners with disabilities. This module is part of a larger project funded by Google aimed at wide-scale professional development focused on computer science inclusion and accessibility. As part of the module, the teachers were asked to examine a technology they used in the classroom as well as taking part in a group discussion of VEX 123 and POUR. This poster presents the findings of the teachers' POUR analysis of the VEX 123.

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https://doi.org/10.1145/3626253.3635576

2 TEACHER POUR ANALYSIS OF ROBOTICS

Data that was used as part of our understanding of how teachers used the POUR framework were: (1) Notes from meetings with the teachers as they described their experiences with the VEX123, and (2) materials that teachers created within their professional development course management system (CMS). These sources of

3 DISCUSSION

There is growing research suggesting that educational robotics can support learners' understanding of computational thinking in engaging ways [7]. However, many of these studies have not focused on the inclusion of learners with disabilities [6], [?]. This study demonstrates POUR as a potential framework to address accessibility.

Although there are ways we could improve the accessibility module presented to the teachers, this study added to ways teachers can

One way for teachers to evaluate accessibility is through using the Perceivable, Operable, Understandable, and Robust (POUR) guidelines. POUR was created to streamline accessibility guidelines for websites. It now can be used to evaluate accessibility, including educational materials.

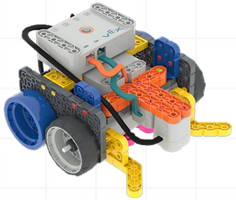
Solutions

The VEX Continuum

VEX 123

Coding Starts Early

Ages 4+



VEX GO

STEM Starts Early

Ages 8+

VEX IQ

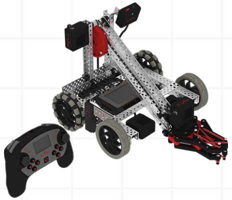
Applied STEM Learning

Ages 11+

VEX EXP

Real World STEM for Classrooms

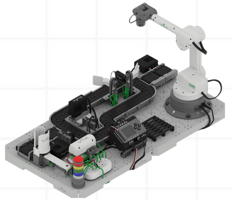
Ages 14+



VEX V5

Real World STEM for Competition

Ages 14+



VEX CTE

Workforce Readiness

Ages 14+

VEX AIR

STEM Skills Take Flight

Ages 14+

VEX CODE VR

Virtual Robot Coding

Ages 8+

The VEX Computer Science (CS) Continuum

VEX 123

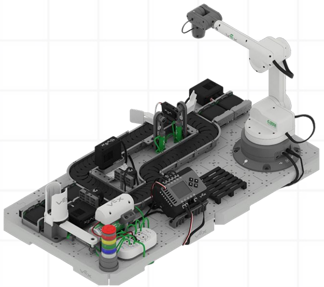
Coding Starts Early

Ages 4+

VEX AIM

Real World Coding

Ages 8+



VEX CTE

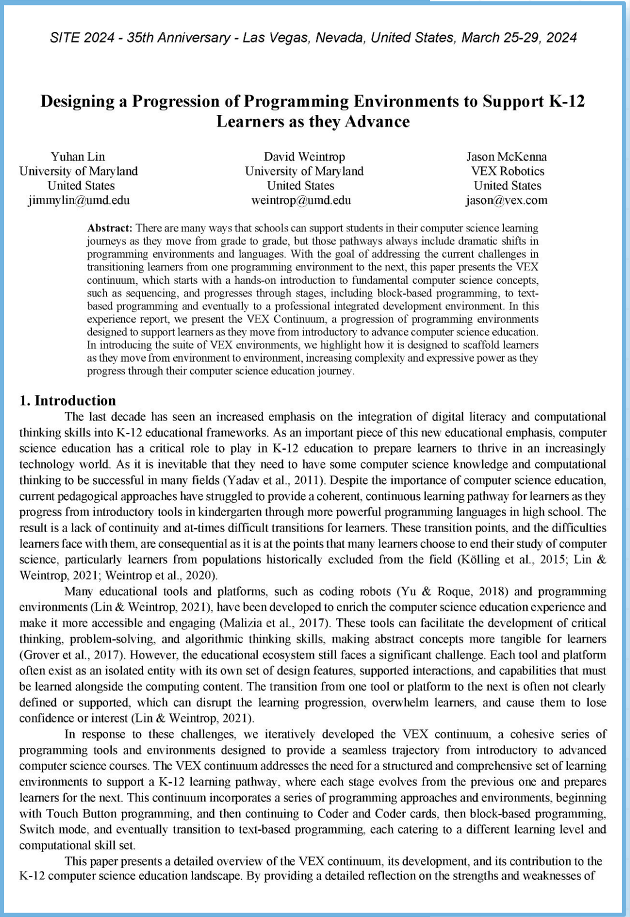
Workforce Readiness

Ages 14+

VEX CODE VR

Virtual Robot Coding

Ages 8+



SITE 2024 - 35th Anniversary - Las Vegas, Nevada, United States, March 25-29, 2024

Designing a Progression of Programming Environments to Support K-12 Learners as they Advance

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Abstract: There are many ways that schools can support students in their computer science learning journeys as they move from grade to grade, but those pathways always include dramatic shifts in programming environments and languages. With the goal of addressing the current challenges in transitioning learners from one programming environment to the next, this paper presents the VEX continuum, which starts with a hands-on introduction to fundamental computer science concepts, such as sequencing, and progresses through stages, including block-based programming, to text-based programming and eventually to a professional integrated development environment. In this experience report, we present the VEX Continuum, a progression of programming environments designed to support learners as they move from introductory to advance computer science education. In introducing the suite of VEX environments, we highlight how it is designed to scaffold learners as they move from environment to environment, increasing complexity and expressive power as they progress through their computer science education journey.

1. Introduction

The last decade has seen an increased emphasis on the integration of digital literacy and computational thinking skills into K-12 educational frameworks. As an important piece of this new educational emphasis, computer science education has a critical role to play in K-12 education to prepare learners to thrive in an increasingly technology world. As it is inevitable that they need to have some computer science knowledge and computational thinking to be successful in many fields (Yadav et al., 2011). Despite the importance of computer science education, current pedagogical approaches have struggled to provide a coherent, continuous learning pathway for learners as they progress from introductory tools in kindergarten through more powerful programming languages in high school. The result is a lack of continuity and at-times difficult transitions for learners. These transition points, and the difficulties learners face with them, are consequential as it is at the points that many learners choose to end their study of computer science, particularly learners from populations historically excluded from the field (Kölling et al., 2015; Lin & Weintrop, 2021; Weintrop et al., 2020).

Many educational tools and platforms, such as coding robots (Yu & Roque, 2018) and programming environments (Lin & Weintrop, 2021), have been developed to enrich the computer science education experience and make it more accessible and engaging (Malizia et al., 2017). These tools can facilitate the development of critical thinking, problem-solving, and algorithmic thinking skills, making abstract concepts more tangible for learners (Grover et al., 2017). However, the educational ecosystem still faces a significant challenge. Each tool and platform often exist as an isolated entity with its own set of design features, supported interactions, and capabilities that must be learned alongside the computing content. The transition from one tool or platform to the next is often not clearly defined or supported, which can disrupt the learning progression, overwhelm learners, and cause them to lose confidence or interest (Lin & Weintrop, 2021).

In response to these challenges, we iteratively developed the VEX continuum, a cohesive series of programming tools and environments designed to provide a seamless trajectory from introductory to advanced computer science courses. The VEX continuum addresses the need for a structured and comprehensive set of learning environments to support a K-12 learning pathway, where each stage evolves from the previous one and prepares learners for the next. This continuum incorporates a series of programming approaches and environments, beginning with Touch Button programming, and then continuing to Coder and Coder cards, then block-based programming, Switch mode, and eventually transition to text-based programming, each catering to a different learning level and computational skill set.

This paper presents a detailed overview of the VEX continuum, its development, and its contribution to the K-12 computer science education landscape. By providing a detailed reflection on the strengths and weaknesses of

"The VEX Continuum is structured to provide scaffolds across the progression from the lowest threshold entry points to the most advanced, highest ceiling..."

Example of Scaffolds

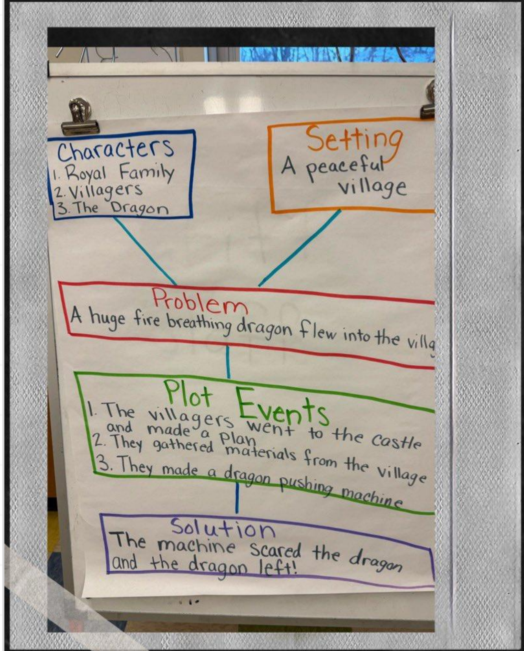
Turtle Creek Elementary STEAM Academy - VEX
@TurtleCreek_Vex

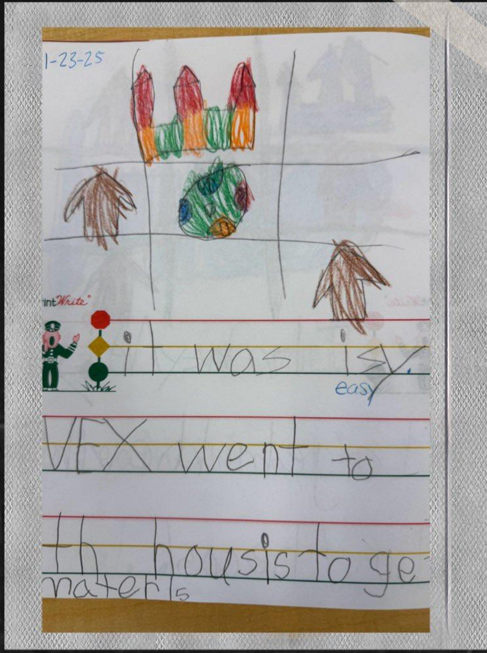
Follow

Kindergarteners in Mrs. Morse's class documented their VEX robotics activity in their VEX notebooks.

#VEX123
#CrossCurricular

Source:
https://x.com/turtlecreek_vex/status/1886557388469076108





Example of Scaffolds

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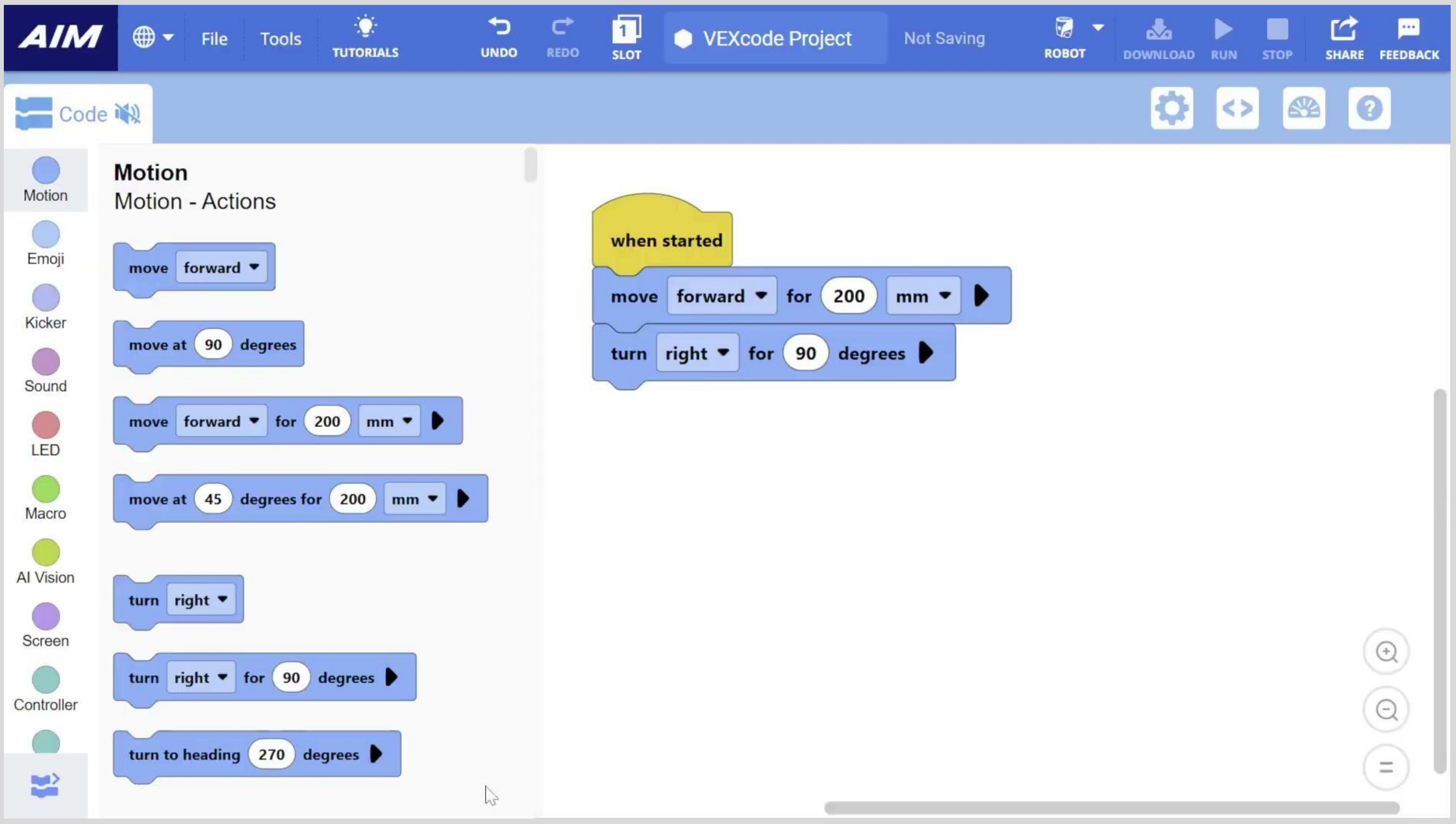
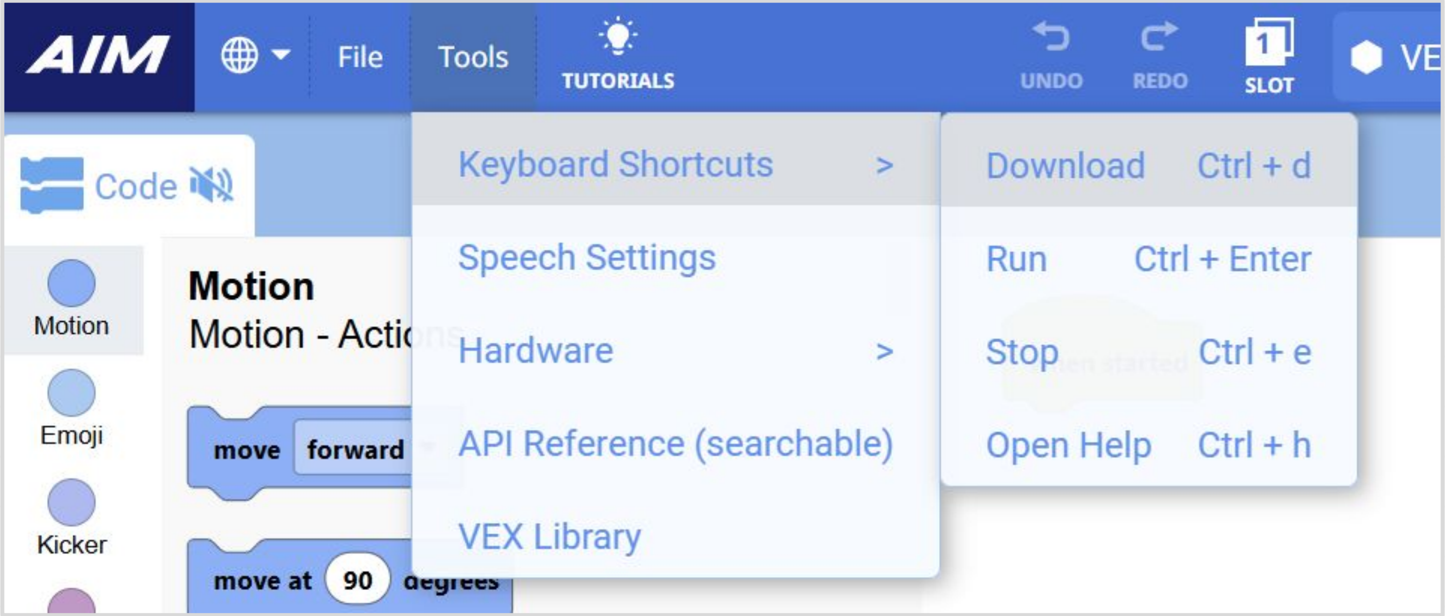
Accessibility: VEXcode - Read Blocks

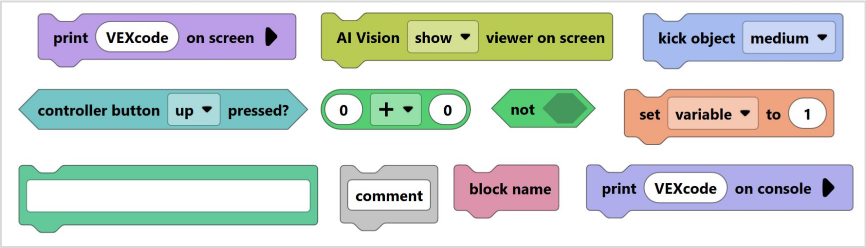


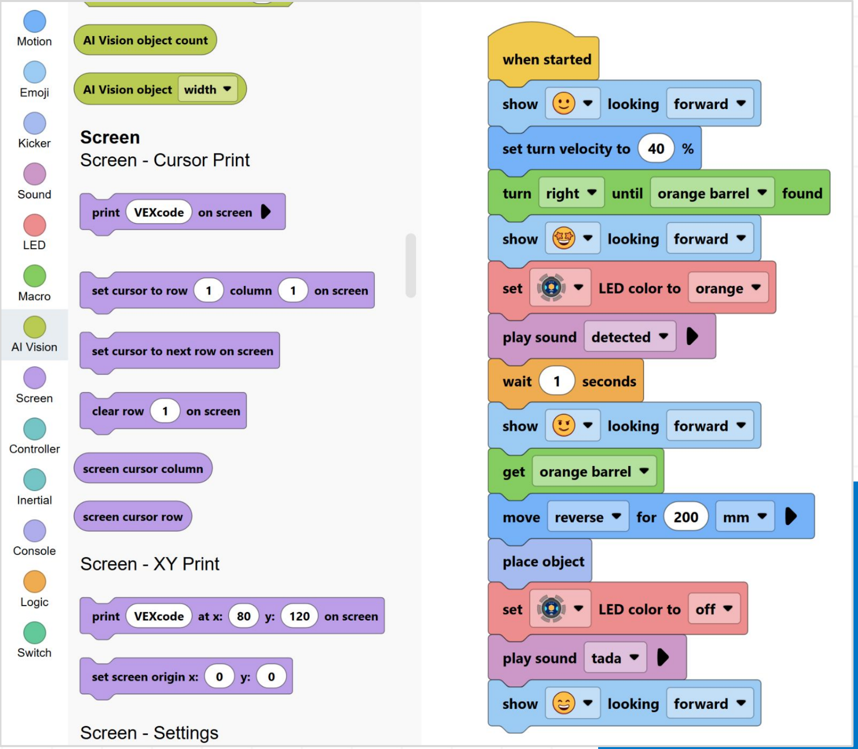
Accessibility: VEXcode - Keyboard Shortcuts



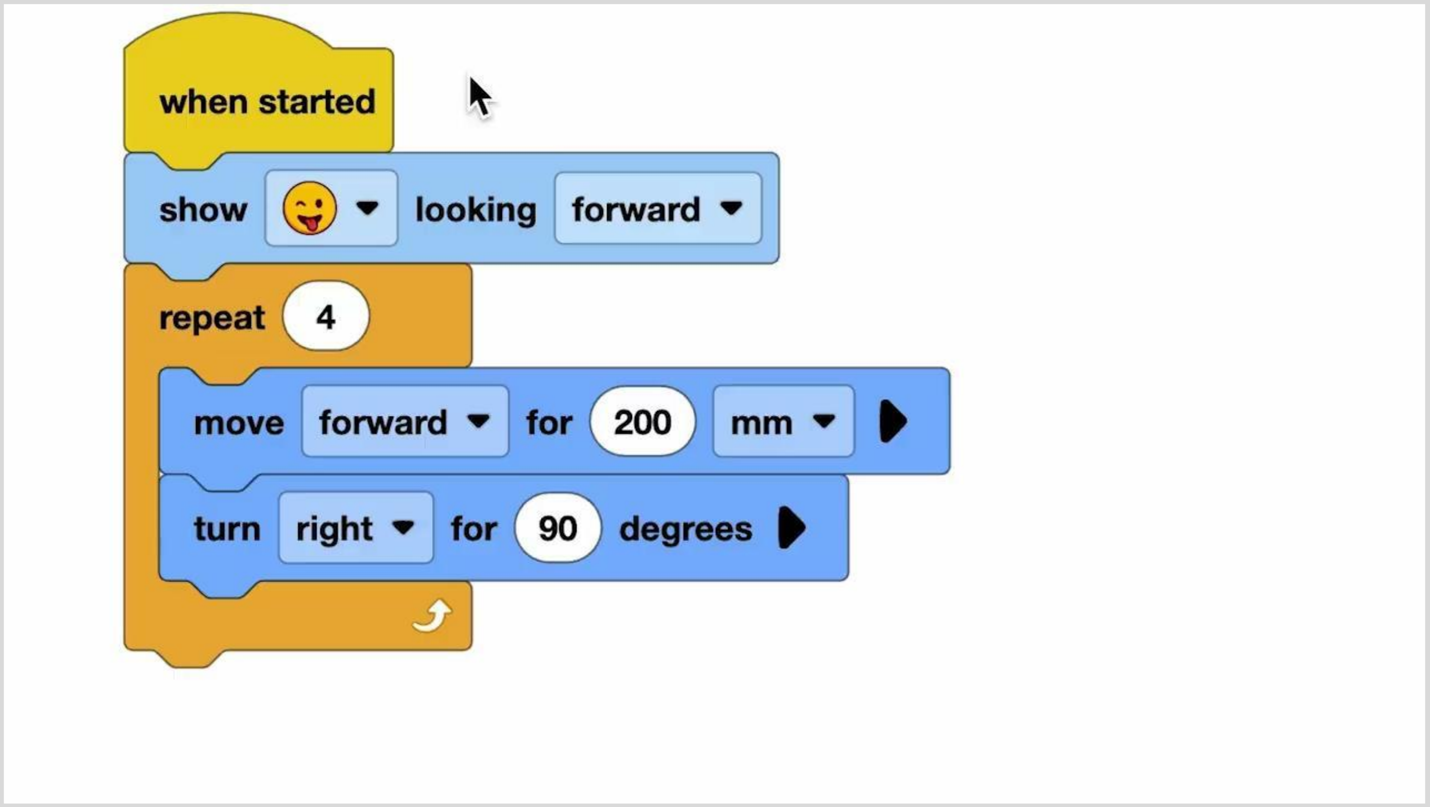
VEXcode AIM: High Contrast Blocks

High contrast blocks built into VEXcode AIM



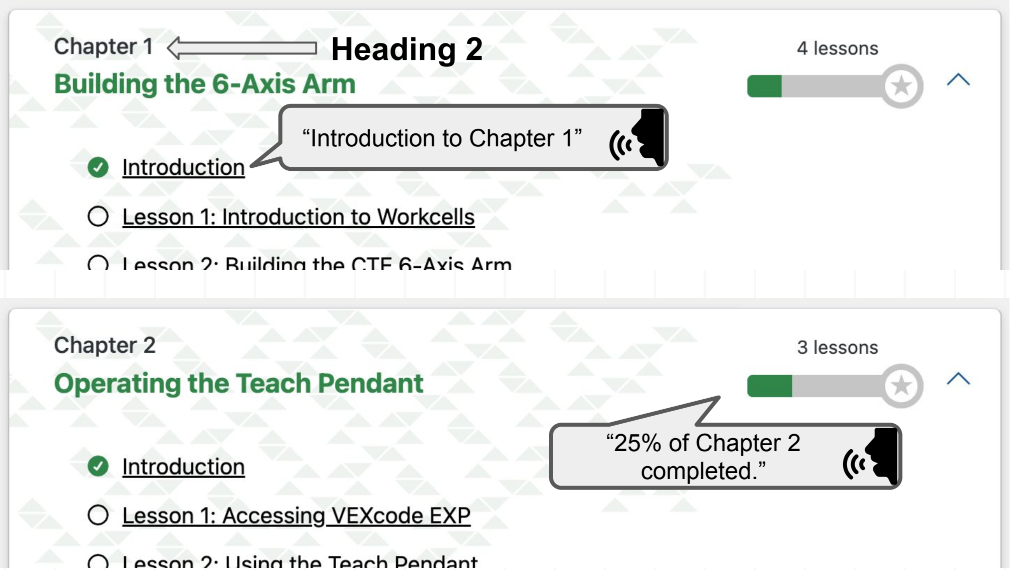


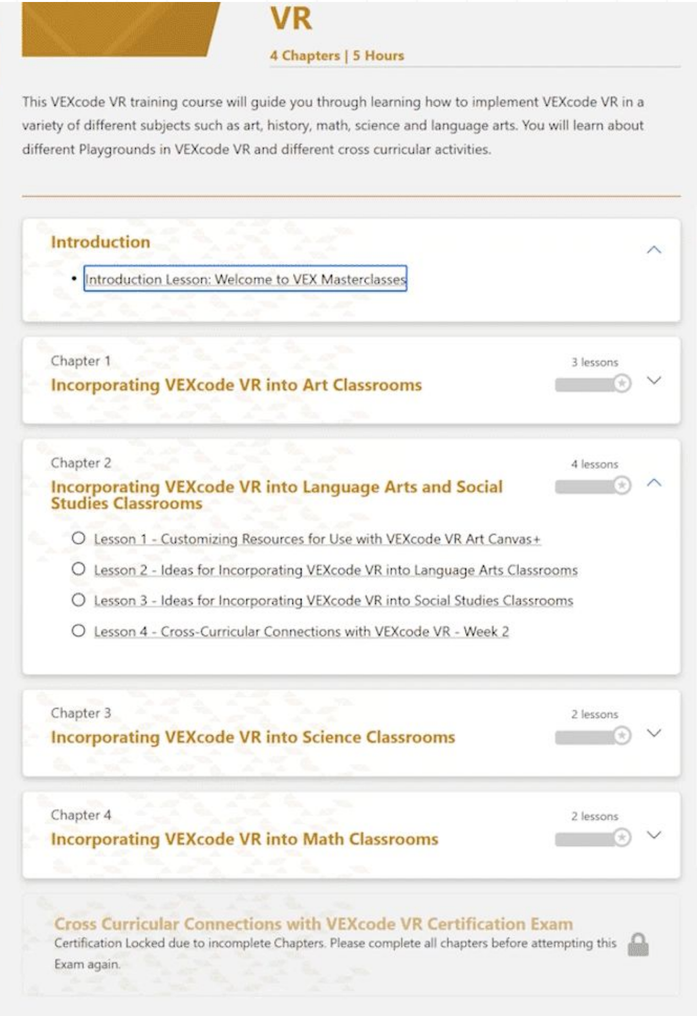
VEXcode Switch Blocks



Accessibility: VEX PD+

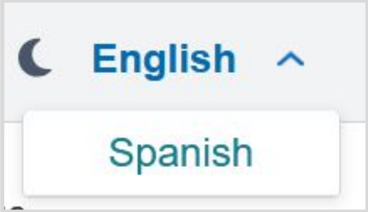
- Screen reader
- Navigate with keyboard





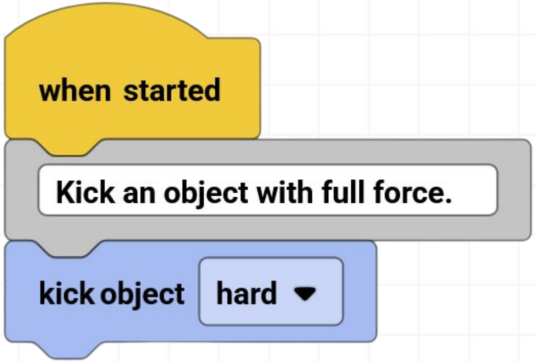
Accessibility: VEX API

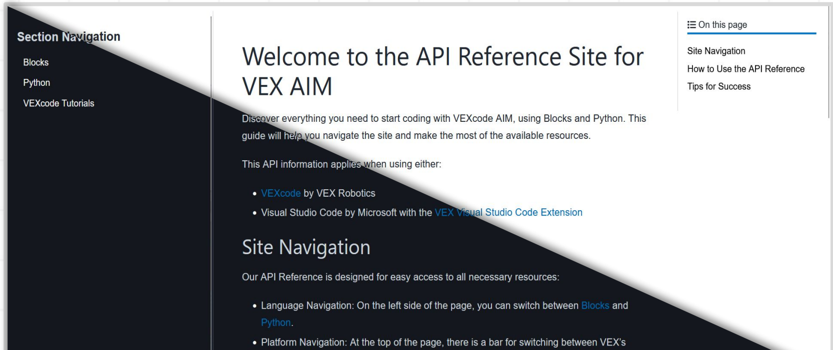
- Navigate with keyboard
- Language options
- Python code copy
- Light / Dark modes
- Screen-reader Blocks

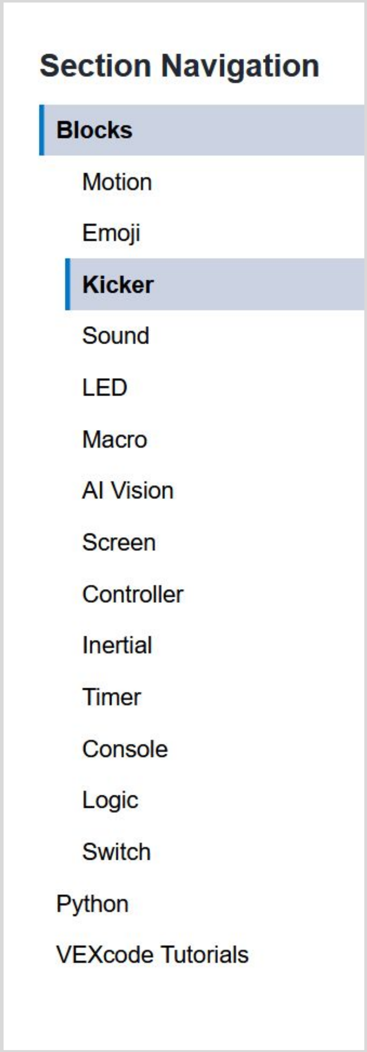



```python
# Wait until note is finished to move
robot.sound.play_note("C6", 1000)
while robot.sound.is_active():
    wait(50, MSEC)
robot.turn_to(180)
```

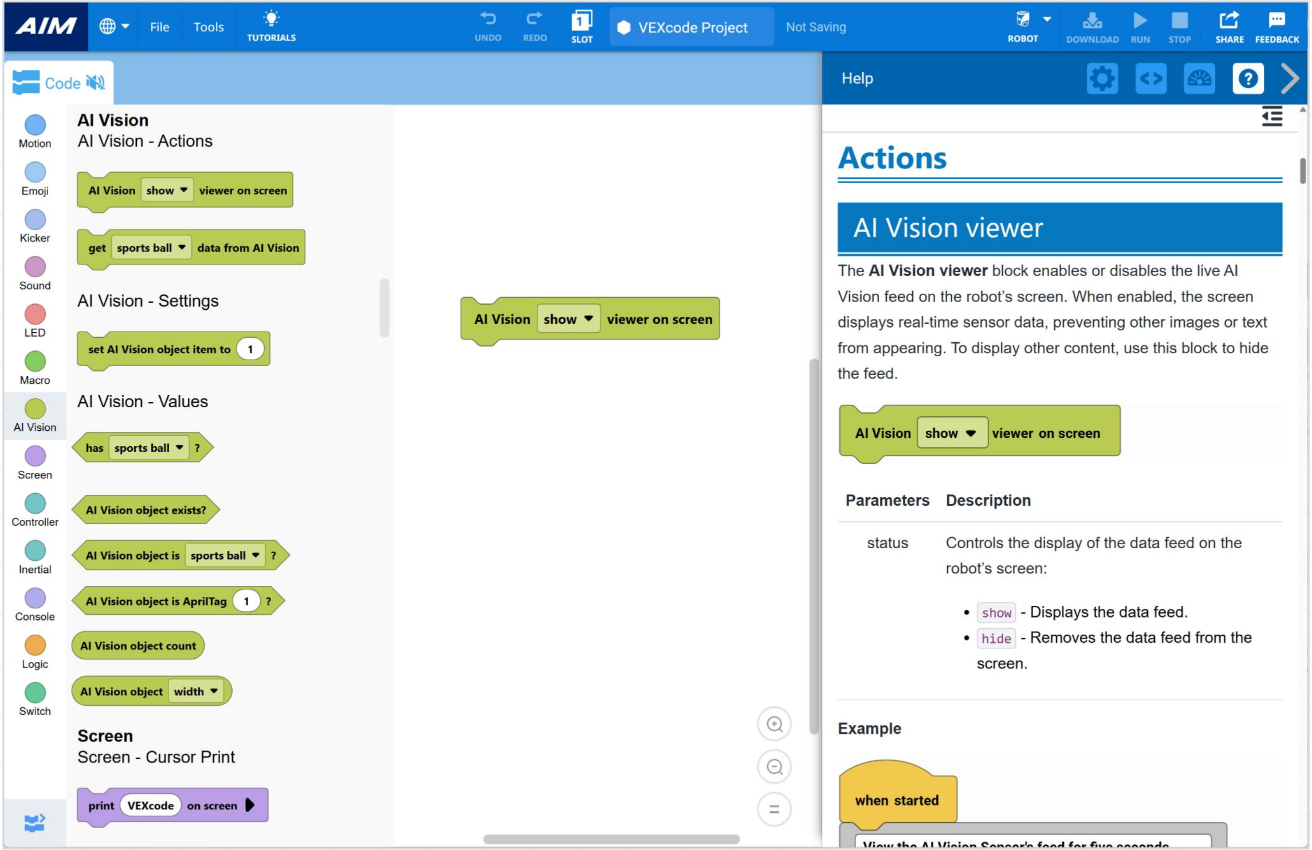
Copy



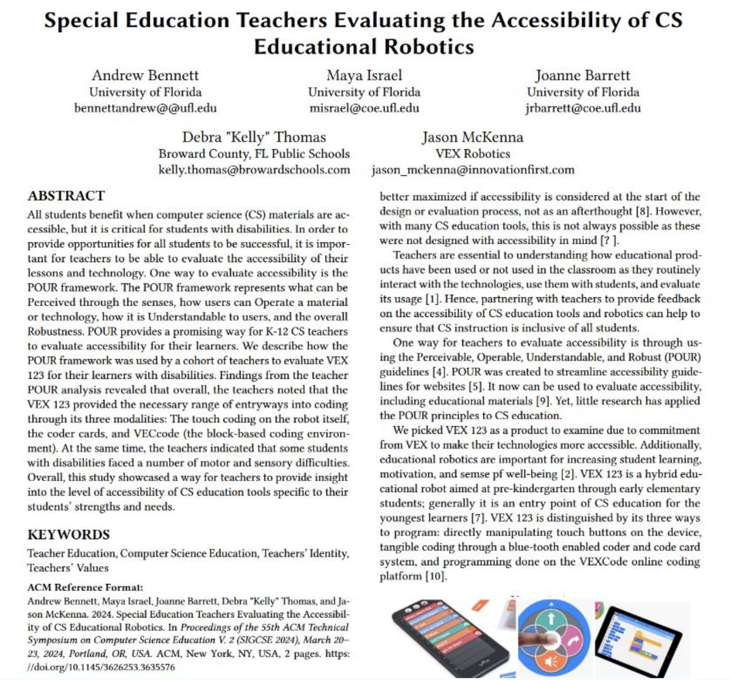




VEX API & VEXcode AIM



Accessibility: Education Website - Descriptive Video



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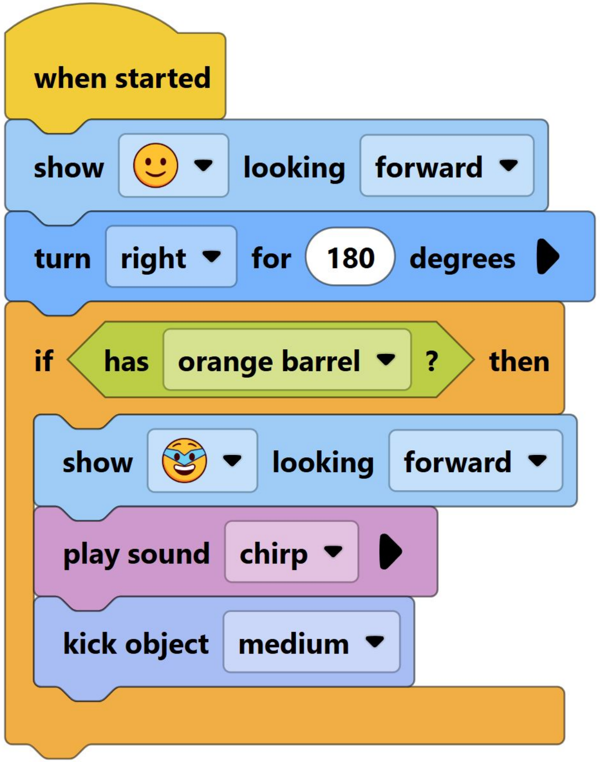
https://research.vex.com

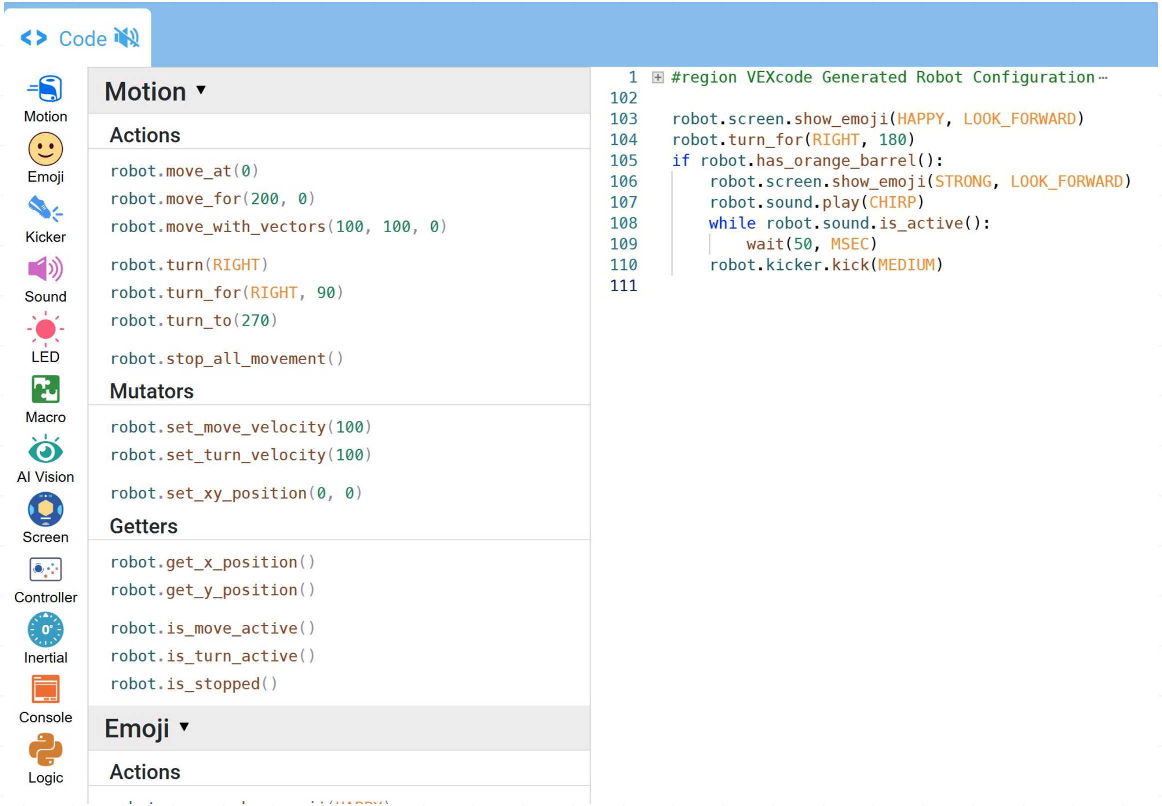
One way for teachers to evaluate accessibility is through using the Perceivable, Operable, Understandable, and Robust (POUR) guidelines.
POUR was created to streamline accessibility guidelines for websites.
It now can be used to evaluate accessibility, including educational materials.

VEX AIM Driving with Controller

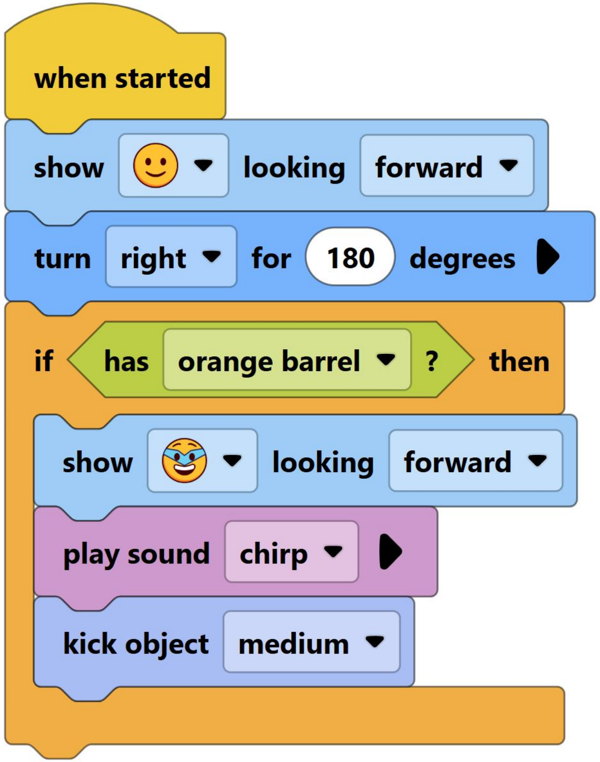
VEX AIM Touch Button Coding

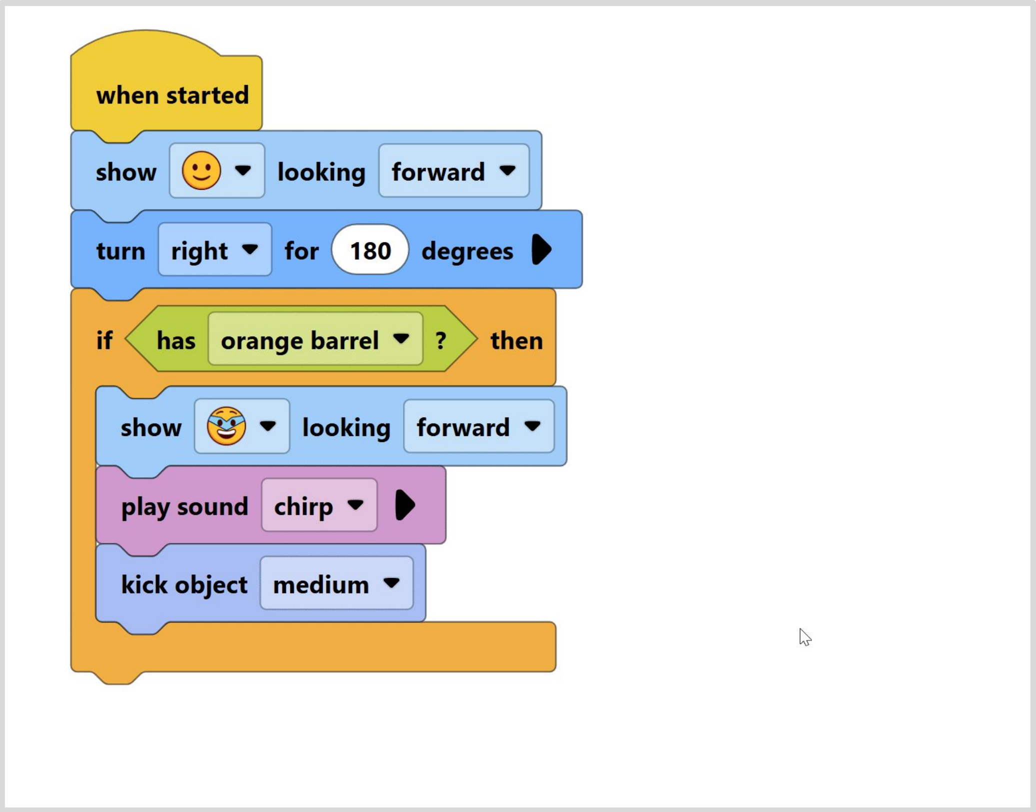
VEXcode AIM Python Coding





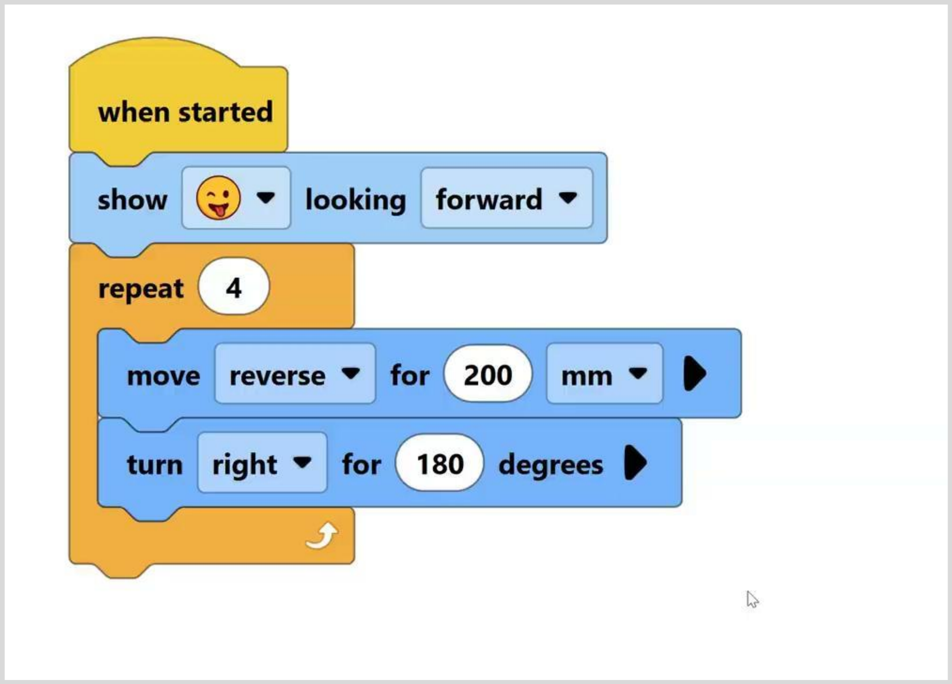
VEXcode AIM Blocks / Switch Blocks





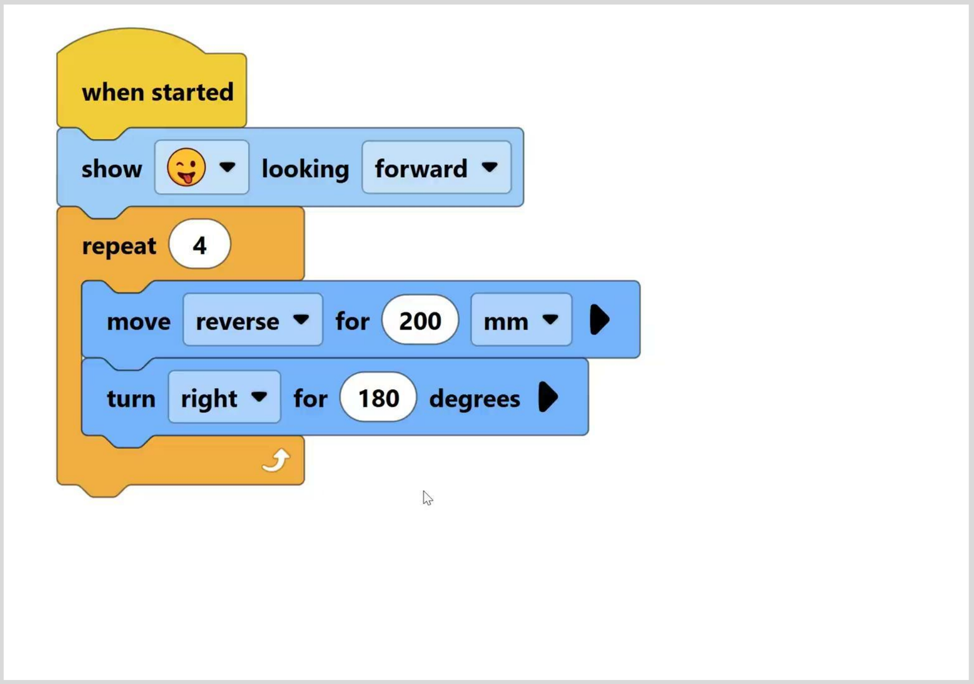
Convert Only

Learners initially compose their program using conventional blocks, including adjusting parameters, before converting the block to Switch mode.



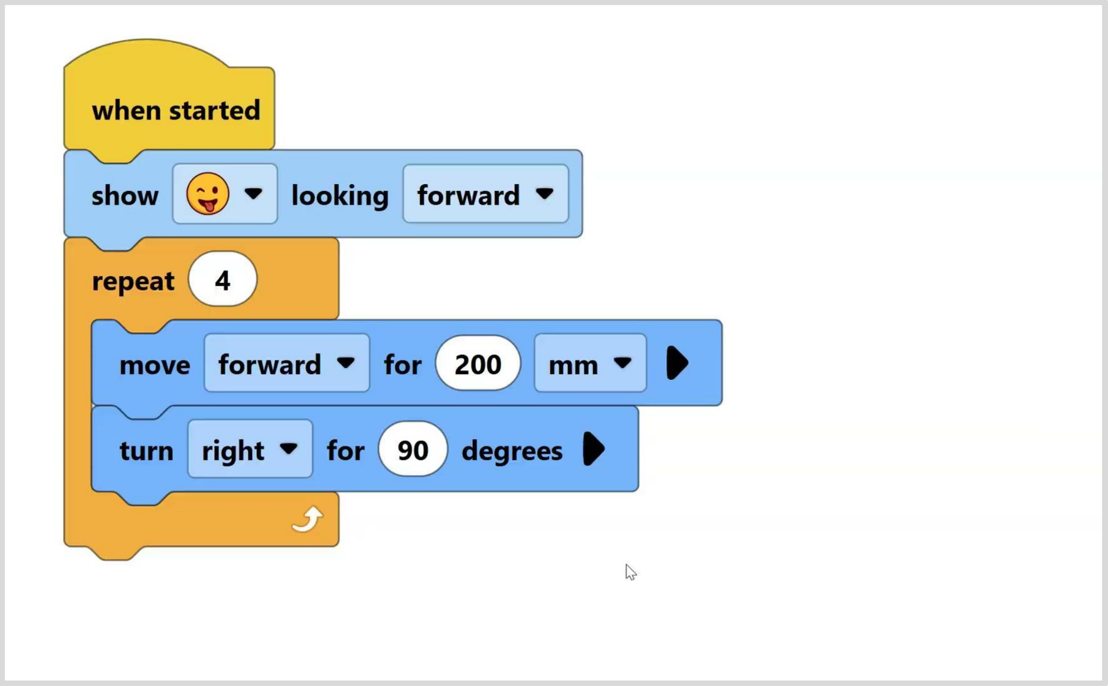
Convert and Modify Parameter

Learners compose with conventional blocks, convert to Switch mode, and then exclusively modify the parameter in Switch mode.



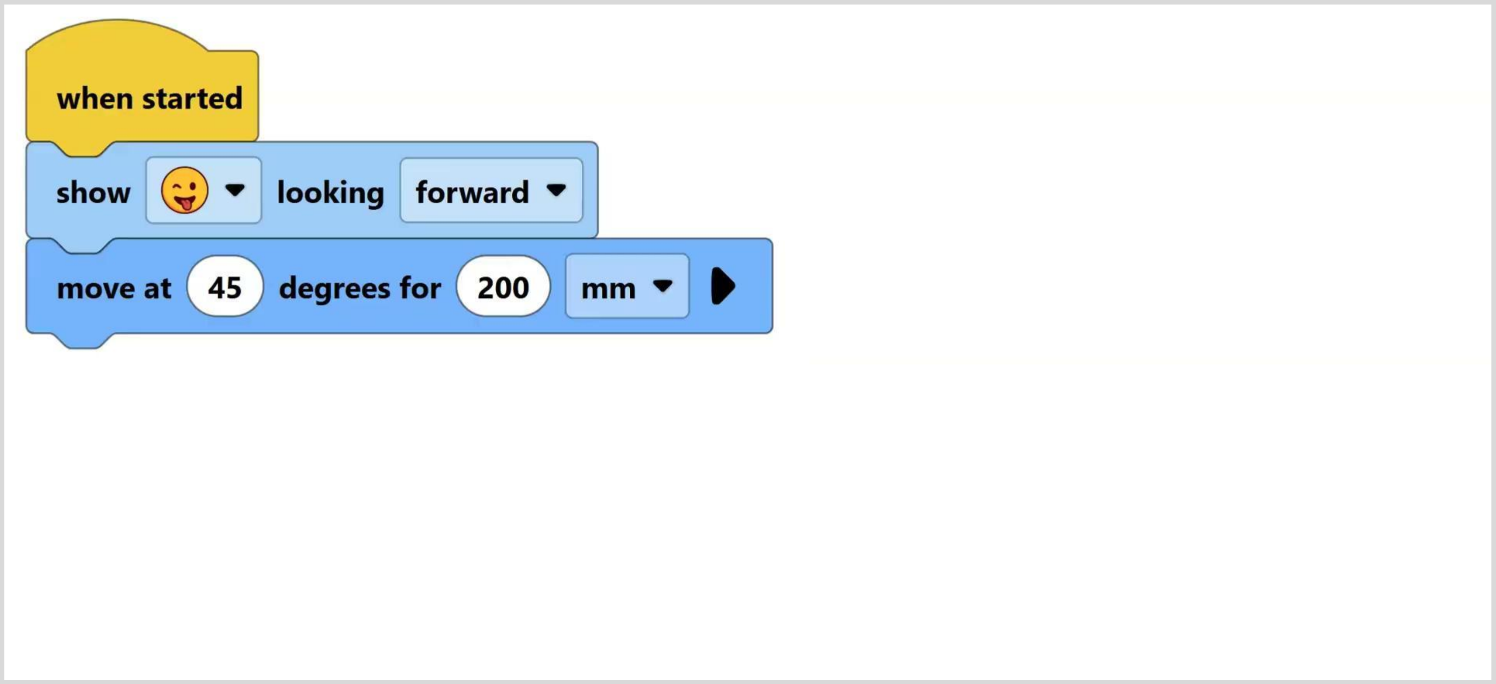
Convert then Reference

Learners compose with blocks, convert to Switch mode and then manually input what they saw in the converted Switch mode block.



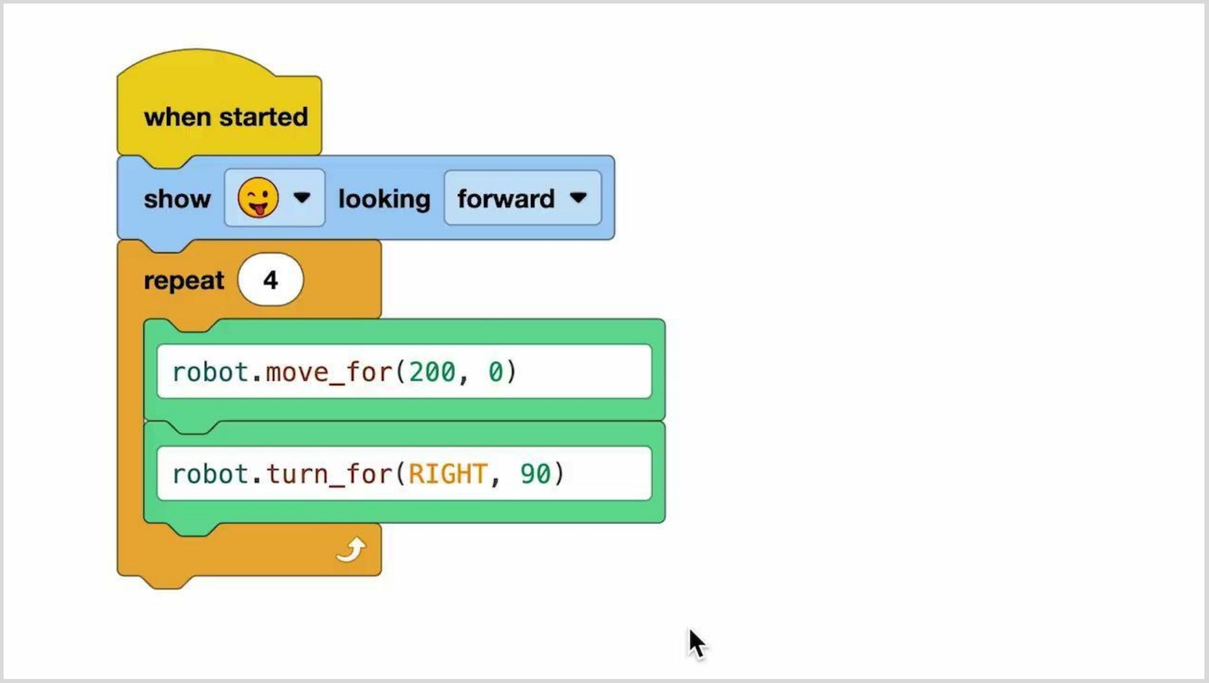
Type, Convert, then Reference

Learners drag a Switch mode block to the canvas, begin typing, then drag a regular block, convert it, and use the converted block as a reference to complete their initially half-typed command.



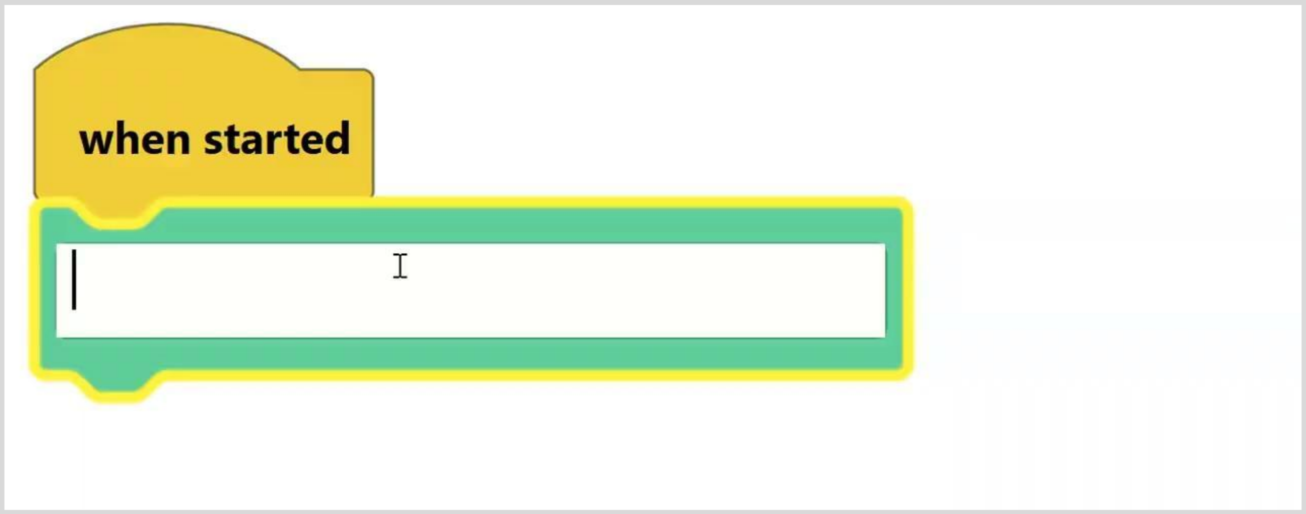
Modify in Switch mode

This involves learners making more alterations in Switch mode than just modifying the parameters.



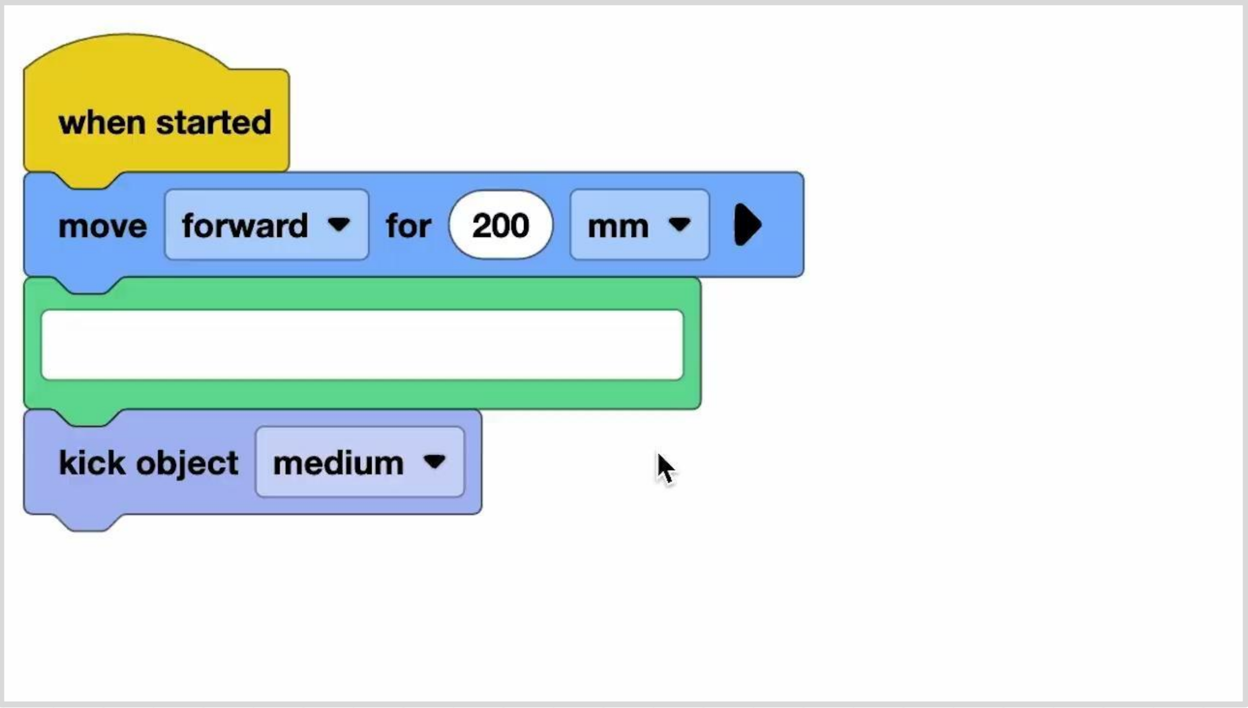
Auto-complete with Error Correction

Learners use the auto-complete feature of Switch mode to fix errors, such as correcting lowercase to uppercase typing, regardless of where these Switch mode blocks came from.



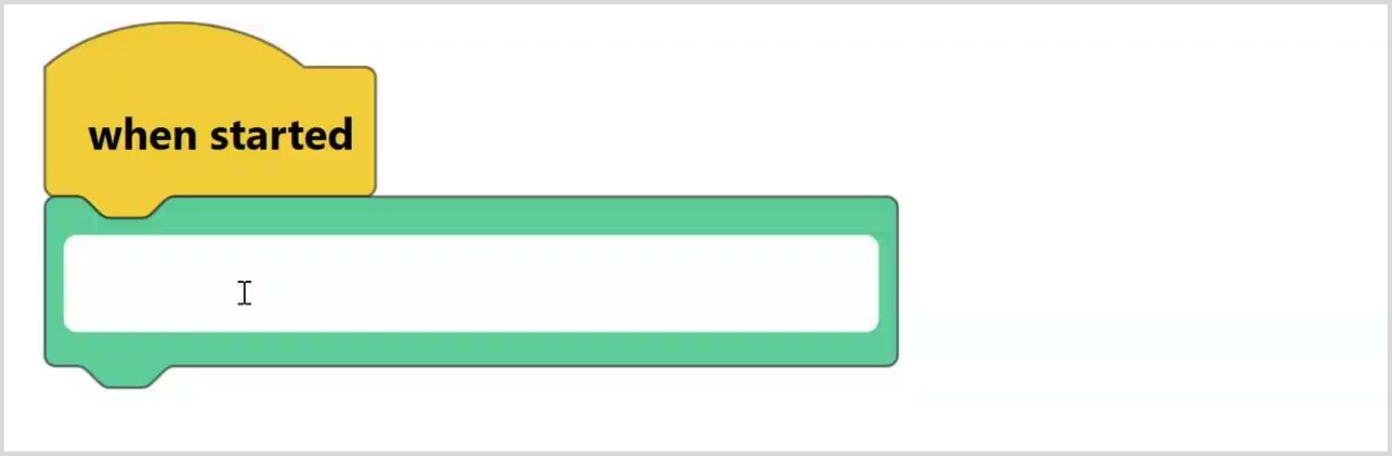
Type with Auto-complete

Learners drag a Switch mode block to the canvas and use the auto-complete feature of Switch mode to complete their Python commands.



Typing without Auto-complete

Learners drag a Switch mode block to the canvas and manually type the command, deliberately not using the auto-complete feature.



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Summary:

- Begin with accessibility in mind
- Work with researchers and experts
- Attack the “real” problem

Questions?

Chat with me and a community of amazing educators in the PD+ Community!