Towards an Adaptable Curriculum-Driven Block-Based Learning Environment

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ABSTRACT

In this poster, we present the design of a browser-based Arduino programming tool, CASMM, to support computational thinking and making in science classrooms. This tool allows for unique integration of research tools, lesson planning, and scaffolding for learning computational thinking concepts and block-based programming. This poster will describe four key features of a block-based LMS: (1) reduced-scoped programming toolbox, (2) block locking, (3) lesson plans and starter code templates; and (4) low-tech code replay for researchers. Through discussion of this tool, we aim to catalyze conversations about integrating new scaffolding techniques into block-based programming environments to better support classroom use and research.

1 INTRODUCTION

There are a plethora of block-based programming environments available for K-12 students to learn to program including tools like SCRATCH, App Inventor, and ArduBlockly. Most of these online programming environments provide static toolboxes with a large number of blocks for students to choose from. Many tools scaffold student learning with external tutorials and complementary curriculum and projects. Some of the tools, e.g., Scratch, offer in-tool tutorials that allow students to navigate and focus on blocks of interest to the tutorial goals. Other tools, such as Code.org's Hour of Code offerings, provide scaffolded lessons that feature reduced-scoped toolboxes with a small set of blocks that are relevant to the coding challenge learners are solving [3]. In addition, Code.org offers a similar curated programming experience through their online learning management system (LMS) that features their curriculum for K-12 students [2]. In our research project, we are studying students' development and use of programming skills in the context of designing Arduino-based experiments in a science classroom. Thus, we were inspired by the ability to offer teachers the opportunity to author lessons in a LMS and to offer a reduced-scoped toolbox to better scaffold these novice programming students.

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2 FEATURES OF CASMM

Our browser-based tool, CASMM, extends the Blockly and ArduBlockly code bases which allows students to write Arduino code using block-based instructions [1] without utilizing multiple tools and allowing for an entirely cloud-based solution. Scaffolding in CASMM is primarily implemented through three features, (1) reduced-scoped programming toolbox, (2) block locking, and (3) lesson plans and starter code templates. The reduced-scoped toolbox makes visible only a few select blocks that are relevant to student's current task. The Block locking feature has two modes of locking: edit lock and movement lock renders code read-only and prevents unintentional deletion of starter code. Lesson plans and starter code templates allow teachers to plan several days of activities and provide students with code templates for specific activities. The design of these features aims to reduce the cognitive load of learning to program and support teachers in integrating programming into non-CS classroom settings. Further, a code replay feature in CASMM allows for a researcher to rebuild a students' actions through log files without any screen or keystroke recording. This allows for a low-tech solution to view a students' process for building, editing, or debugging programs.

3 CONTRIBUTIONS AND FUTURE WORK

CASMM is a novel combination of features and a model for block-based LMS authoring tools that shifts the power to teachers to design for and scaffold content to the unique needs of their students as well as allows researchers to view the development of student programming rather than only viewing the end product. Future work includes usability and efficacy studies of this tool. This system will hopefully start conversations about what features to include in a block-based programming LMS designed for classroom and research use. A public version is at https://www.casmm.org/sandbox.

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