

A Conceptual Assessment Framework for K-12 Computer Science Rubric Design

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ABSTRACT

The lack of effective guidelines for assessing students' computer science (CS) competencies is creating significant demand by K-12 teachers for CS assessments to evaluate students' learning. We propose a conceptual assessment framework that guides teachers through designing appropriate assessments for computer science (CS) activities in their classrooms. The framework addresses the critical problem of incorporating CS into K-12 curricula without corresponding assessments. We illustrate its use with the design of a rubric for a bubble sort algorithm situated in a game-based learning environment for middle-grade students. We also apply a preliminary and a revised version of this assessment on two datasets collected from students' interactions with the learning environment. We found consistency among results identified through applying the preliminary and the revised rubric. The results reveal distinctive patterns in students' approaches to CS problem solving and coherency with respect to different aspects of the rubric.

KEYWORDS

CS Assessment; Evidence Centered Design; K-12 CS Instruction

1 INTRODUCTION

Recent years have seen a growing body of curriculum developed for teaching programming and computer science to K-12 students. However, there is not much emphasis on how to effectively assess students' understanding of the embedded CS concepts [1]. This is particularly challenging for non-CS teachers. In this poster, we present a conceptual assessment framework that guides teachers through designing robust rubrics for CS assignments. Our framework adopts an evidence-centered assessment design approach [2] and uses a hypothesis-driven assessment framework proposed by Grover et al. [1]. Evidence-centered assessment design has been used successfully to assess students' skills and knowledge constructs in a broad range of game-based learning environments and simulations [2, 3].

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SIGCSE '20, March 11–14, 2020, Portland, OR, USA.
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ACM ISBN 978-1-4503-6793-6/20/03.
<https://doi.org/10.1145/3328778.3372643>

2 METHODS AND RESULTS

We utilize this framework to design a rubric for a bubble-sort challenge situated within a CS game-based learning environment. Following the presentation of the assessment framework, we identify CS concepts that are required to solve the bubble sort challenge. We then extract and evaluate features and patterns of interaction that are representative of students' competencies in the CS concepts identified. A three-dimensional rubric is then designed to assess students in accordance with their competency in essential CS concepts, their dynamic testing and refining strategies, and their problem-solving efficiency. We revise and apply this rubric on data collected from a total of 91 students over two studies. The primary finding of analyses from these studies is that students' knowledge of essential CS concepts is the foundation for their ability to develop effective algorithms.

3 CONTRIBUTIONS AND FUTURE WORK

This work provides an important first step toward a rigorous approach for designing assessments for CS activities. An important direction for future work is to evaluate its effectiveness by conducting interviews with teachers and comparing teacher-designed with expert-designed assessments.

ACKNOWLEDGMENTS

This research was supported by National Science Foundation (NSF) Grant DRL-1640141. Any opinions, findings, and conclusions expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

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