Metacognition in Computer Science Learning:

Perception vs. Reality

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# Introduction

Computer Science (CS) education is highly sequential, and courses rely heavily on concepts learned in prerequisite courses. Beyond learning important abstract concepts, students taking these introductory courses must also learn concrete programming language specific commands, syntax, and conventions. The amount of information that CS students must assimilate in a short period often requires instructors to abridge the material that they cover and focus on abstract concepts, leaving students with little applied understanding. This is particularly concerning for introductory CS courses where students are expected to build upon these foundations; incomplete understanding of concepts and learning loss during school breaks are significant issues that impede students’ academic success in CS. To mitigate these obstacles, a large, urban university created a program that provides foundational support through a four-day online winter intersession review “bootcamp” as a bridge between their introductory and intermediate computer science courses. This program aims to improve student academic success by boosting students’ confidence, ensuring a solid understanding of foundational concepts, and reducing learning loss during the school break. To help increase student learning and assist the instructor in assessing student progress, metacognitive tasks (i.e. tasks requiring students to reflect on their own learning) were integrated into the program each day. These tasks were meant to assess student self-efficacy and to assist the instructor in providing an appropriate balance of academic support and challenge (Vygotsky, 1978; Wood & Middleton, 1975; Wood et al., 1976).

This study aims to explore students’ subjective experiences and perceptions of learning in a voluntary intersession CS review bootcamp. It seeks to understand how students navigate the learning process, the challenges they face, and their perceived proficiency, as well as the relationship between student and instructor perceptions of student progress and learning.

# Methods

First year college students majoring in Computer Science participated in a voluntary four day

winter intersession bootcamp-style review and preparation clinic between their first and second

semesters at a large, urban university. . The participants received a total of twenty hours of instruction and lab exercises divided equally into the four days. Each participant was asked to

complete daily surveys administered via Google Forms about the efficacy and enjoyment of class activities, learning outcomes, and self-assessed proficiency; surveys contained both Likert-type and open-ended, written response questions. Written notes from the instructor were collected on the content of instruction, observations from each session, and reflections on student engagement and proficiency.

# Results

Data collection is complete, and mixed methods (qualitative and quantitative) analysis of results are underway, with expected completion by October 2024. An average of twenty-one students participated in the clinic and a total of 42 surveys were collected over the course of four days; an average of 10 surveys were collected daily, with a completion rate of 48%. As proposed by Braun and Clarke (2006), a thematic analysis of the student survey responses will be conducted and descriptive statistics will be compiled The instructor’s notes will be paired with thematic analysis and descriptive statistics to provide insight of either confirmation or contradiction between the students’ self-reported experiences and the instructor’s observations. Preliminary analysis of the survey responses suggests that students and the instructor often viewed the students’ progress and experiences differently. Students reported a high level of enjoyment and extracted learning benefit; in contrast, the instructor’s notes do not suggest significant enjoyment from the students, and the instructor believed that student engagement was low. Students reported confidence in their understanding of some basic programming concepts, but instructor observations indicated that this confidence may be misplaced.

# Discussion

This study aims to explore the relationship between students’ self-assessed experiences and instructor-observed performance and engagement. Preliminary results suggest that students and the instructor viewed the student’s experience and learning differently. . This mismatch in perspectives has implications for future instruction, and may point to limitations in the “bootcamp”-style instructional modality, the students’ capacity to effectively engage in metacognitive exercises, and/or instructor ability to adequately assess student engagement in an online teaching format. Although this is a study of college students, results may translate to secondary schools or other settings where sequential STEM classes are offered. As K-12 schools seek solutions to increase student academic success, improve learning outcomes, and mitigate learning loss and during school breaks, these findings provide insight into the efficacy of one potential solution. An expanded discussion, limitations, and implications for practice will be provided.

# References

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