Metacognition in Computer Science Learning: Perception vs. Reality

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1 Abstract

Students majoring in computer science often have little to no computing experience before entering college and this can affect students' confidence and performance throughout their education [1]. To mitigate this obstacle, we attempt to boost students' confidence, reduce learning loss, and provide foundational support by offering a four day online winter term bootcamp as a bridge between their introductory and intermediate computer science courses. This is a qualitative case study examining the experiences of Computer Science students that participated with an emphasis on self-efficacy and the importance of providing scaffolding to ensure that they stay within the zone of proximal development [3, 5, 4]. Although this is a study of college students, results may translate to secondary schools or other settings where introductory computing classes are being offered.

2 Introduction

CS education is highly sequential, where courses rely heavily on concepts learned in prerequisite courses. A course in Data Structures has substantial reliance on Object Oriented Programming concepts, which, in turn, relies on understanding of Control Structures. 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.

This study aims to explore students' subjective experiences and perceptions of learning computer science in a voluntary intersession bootcamp-style review and preparation clinic. It seeks

to understand how students navigate the learning process, the challenges they face, and their perceived proficiency. By investigating these experiences, we hope to provide insights that can assist instructors with supporting student metacognition by providing them the scaffolding to practice an learn at any level.

3 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 San Francisco State 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 open-ended surveys administered via Google Forms about the efficacy, enjoyment, learning outcomes, and self-assessed proficiency of each day's activities. Notes from the instructor were collected on the content of instruction, observations from each session, and reflections on student engagement and proficiency.

4 Results

Data collection is complete, and qualitative and quantitative analysis of results are underway, with expected completion by August 15, 2024. Twenty-one students participated in the clinic and a total of 42 surveys were collected. As proposed by Braun and Clarke [2], a thematic analysis of the student survey responses shall be conducted. The instructor's notes will be paired with the thematic analysis to provide insight of either confirmation or contradiction between the students' self-reported experiences and the instructor's observations.

Initial analysis of the survey responses suggests that students reported a high level of enjoyment and extracted learning benefit. Surprisingly, the instructor's notes do not suggest significant enjoyment from the students, as student engagement was found to be lacking. Students reported confidence in their understanding of some basic programming concepts, but instructor observations indicate that this confidence may be misplaced.

5 Discussion

While metacognition has been extensively researched and is a crucial aspect of learning, studying any disparities between computer science students' perceived understanding and actual performance has not seen much, if any, attention. Moreover, the instructor's observations of student

engagement also did not seem to match the students' self-reported enjoyment and extracted learning benefit. This study aims to explore the relationship between students' self-assessed experiences and instructor-observed performance and engagement. Initial results from the bootcamp clinic suggest that students may not fully understand their own proficiency in programming concepts, which could have implications for future instruction. Likewise, the instructor may not be fully understanding the level of student engagement and enjoyment, which could impact the design of future learning experiences. An expanded discussion, limitations, and implications about these complex relationships will be provided in the forthcoming presentation to help inform the practices of school psychologists.

References

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