SAGE PROJECT PROPOSAL

Parson's Programming Puzzle and Code Completion Field Study

Ben Bae
Jady Tian

INTRODUCTION

Computational thinking was a concept coined by Seymour Papert in 1980 that described a new type of problem-solving approach, in a way that a computer would execute. Today, it is a universally accepted skill set that can be used in a variety of fields, not just computer science, but any job that would require one to think computationally. Therefore, it is important for students these days to acquire and master computational thinking, and SAGE looks to improve the efficiency and effectiveness of teaching and learning computational thinking, eventually scaling up bigger.

SAGE creates a friendly learning environment in Scratch for students to not only enjoy the process of coding, but also gain computational thinking. Therefore, our main goal is to prepare and conduct formative evaluations of field studies to garner data for the actual pilot test case in South Bronx Early College. A comparison between students' performances and ways of navigating through quests in Parson's Programing Puzzle and Code Completion will be used to demonstrate different aspects of Computational Thinking students utilized when solving problems on Scratch. We plan to use students' performance in Parson's Programming Puzzle as a baseline while taking a closer look at the methods in which they complete Code Completion. Specifically, we want to look at a comparison between students' performances and ways of navigating through quests in Parson's Programing Puzzle and Code Completion, to see the difference in efficiency of grasping CT ideas.

DESIGN AND IMPLEMENTATION OF CODE

Before jumping straight into the field work, however, we would like to first take a look at the code of SAGE, to not only understand better what we are working with but also to present a finalized product during the field studies. The best ways to do so would be to look for solutions for the bugs already found, and attempting to add on some features suggested within Parson's Programming Puzzles.

For example, one bug (NO. 481) that we were looking at involves an instructor using Mission Management, in which when the user clicks on a new mission, they are taken back to the top of the page and need to scroll down to access said mission. We can correct this using adding a drop-down menu as opposed to taking the user back to the top of the page, making the experience more user friendly and the User Interface less frustrating.

If time allots, we can also take a look at the scoring system feature that was implemented to measure a student's progress and capabilities through SAGE. The theories behind the scoring systems involve aligning the four computational thinking concepts: deliberate approach, abstraction, iterative design, and learning studies. However, it is yet to be fully implemented in

the HUD of the game, and also can be improved upon using the higher order concepts to observe patterns of the students, and judge a student's progress accordingly. This type of scoring system would be very useful in the actual field study as both a statistic to measure the overall effectiveness of SAGE but also a good indicator of an individual student's progress.

FIELD STUDY

1. Preparation:

After the completion and understanding of the code as stated above, we would then go on to prepare for actually going out for the formative evaluation. Our first step would be to design surveys based around the ISTE Standards of Computational Thinking Competencies, and analyzing the results with how well SAGE's program assists with computational learning. We would pick ISTE's definitions because these theories has proven to improve abilities, deal with open ended problems, and raise tolerance for ambiguity- skills necessary to develop at a young age to develop strong critical thinking and algorithmic skills. Specifically, we would want to target the children's abilities of Decomposition, Pattern Recognition, and Algorithm Design, which are the most powerful tools in computer science to master; therefore, we would ask pointed questions in the survey that measure the development of said skills.

For partners we could potentially work with during this field study, our main group to consider is Coder Kids, an afterschool program designed to teach children programming through different means of self-created curriculum. As Jady Tian is currently employed here teaching kids about programming using Scratch, we have the connections and the means to extend that into SAGE's field studies. Moreover, we also have other, more local schools that we could also connect with. In the past, SAGE has connected with PS175 and are maintaining correspondence with PS76 as well, and these could be secondary locations to conduct our surveys for the pilot release.

2. Implementation:

2.1 Introduction and Setup

In this section, we will go into details explaining how we plan to evaluate the efficiency of Parson's Programming Puzzle and Code Completion. In general, for Parson's Programming Puzzle, we would expect the CT ideas of breaking down the quest and recognizing the patterns to play a great part in the process of solving the problem. However, for Code Completion, because some blocks are purposefully missing, a need to abstract principles becomes more significant. Offering task instructions in a similar manner, we plan to split up student groups based upon age group and gender to see if there's any correlation in their way of solving problems. A focus on the choice of non-CT related vocabulary will also be needed and specific ways of implementation will be discussed after reading through some related research.

2.2 Evaluation System

Basic scoring system will be consisted of the time it takes for the student to complete the task as well as the number of correct cases. The number of times hints are used will also be taken into consideration and this criteria is especially important in the case of Parsons Programming Puzzles as there are limited cases to be tested out sometimes.

A system of tracking the student's thought process throughout the task will be needed to analyze the kind of CT idea he/she utilizes. After the study, students will be asked to fill out a short survey, with the basic information such as age and gender, and prior knowledge, while also involving questions relating to the difficulties of the questions and their own sense of improvement in their cognitive and problem solving abilities.