PROPOSAL
Parson Programming Puzzles and Field Studies

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0.1 Abstract

The main focus of this semester is progress on Field Studies. In this report, I will discuss the progress currently made as well as plans for possible Field Studies options. To support the current field study with Elissa, there are modifications on the puzzles as well as their instructions. Besides, the construction of the distraction condition and Scratch condition may be improved upon to make the students' learning experience more positive and efficient. In the future, depending on the previous CT related exposure of students in other schools, I am planning on developing other puzzles and lessons, such as loops and conditionals.

0.2 Introduction

SAGE is stands for Social Addictive Gameful Engineering. The prominent goal of the SAGE environment is to provide teachers a space to design puzzles for students and teach them about computational thinking in an gameful and self motivated manner. Computational thinking(CT) is the ability to express problems and provide solutions in a way computers execute problems. This useful in the current culture because there are a higher demand for jobs and social roles that require computational thinking skills outside of the field of engineering. In order to evaluate the clarity and effectiveness of the platform, and to improve from meaningful feedback, we plan to conduct field studies in a wide range of schools in NYC. Therefore, we can gain insight from both the teacher and student perspectives, which are the two main target user of this platform. In addition, I plan to test this with college computer science major students to gain feedback for the design and construction.

0.3 Related Work

0.3.1 Learning Programming from Tutoials and Code Puzzles: Children's Perceptions of Value

The paper by Harms, Balzuweit, Chen and Kelleher surveyed children's preference of learning style. They found that while 17 percent of the students would choose Puzzles for challenging concepts, 41 percent of the students prefered to start with a tutorial and then move on to puzzles. A comment from a student during an interview seems

rather insightful. He said that he preferred tuturials because puzzles are novel to him and he worried he wouldn't understand what the puzzles are trying to teach him. Such worry explains the current popularity of instructional learning, which the students are being taught a specific concept. In my opinion, SAGE has the oppotunity to address such problem by making every step of the learning experience as transparent and clear as possible. This includes unambiguous puzzles instructions, design, progress report, feedback and scoring system. In this way, students can gain a wealth of information in turns of their goal, performance and understanding of current concept. Thus, this address the problem brought up in the paper regarding possible confusion and unclear goals associated with Parson's Problem learning style.

0.3.2 Distractors in Parson's Problems Decrease Learning Efficiency for Young Novice Programmers

Another paper by Harms, Chen and Kelleher address the usage of distractors in Parson's problems. A distractor is described as a way to address common misconception, like the distractors in a multiple choice question. However, a distractor in this context has many implications. They claim that while distractors increase cognitive load, it decrease learning efficiency and effectiveness. During their studies, they used three kind of distractors: 1)add unrelated random noise, 2)add tangentially related noise, 3) add unrelated control flow constructs. While the first two kind of distractors are easily being identified, the third kind was reported to be harder to spot. Thus, it allowed students to think about the necessity of each block and the logic flow of the puzzles. In our case, I think creating distractors of such kind could potentially encourage students think more deeply about the computational logic within each puzzle. Besides, the necessity of a sub-optimal path is also being discussed. While this idea is might not apply to sequences, I think this the an interesting idea for future lessons. It is found that providing a sub-optimal solution sometimes prevents students from discovering the optimal path. However, when there there are incomplete sub-optimal path distractors, it eventually push students toward the optimal path solution.

0.4 Proposal

0.4.1 Parson's Puzzle Improvement

There are current two main issues that should be fixed or worked on. Firstly, the instruction of each puzzle is currently ambiguous and prevents students from gaining a clear understanding of the goal. Therefore, I am revising the instructions of all of the puzzles to make it more structured and understandable. Secondly, I am changing the design of some puzzles also in the aiming of clarity for students. This involves correcting some animation components of the puzzles as well as adding and removing blocks from the current solution to make the puzzle building experience smoother. Thirdly, Jeff and I are working on a way of making the students' score and progress more transparent to them. For example, by telling them that their progress is a reflection of their score performance, or communicating what is the maximum score they are get.

0.4.2 Continued Field Studies

Currently, I am in close communication with Elissa Levy, a teacher from Life Sciences Secondary School. We have scheduled a video meeting on February 20th. We will go over the modifications of puzzles made, distribution of materials in class, the new survey distribution method and suggestions on the Scratch environment. We want to find a way that distributes login information and instructions most efficiently. Our current method is to deliver them as printed copies, but it could use up much time since we have three conditions. Furthermore, we want to discuss ways to make the Scratch condition easier to understand since they don't have the blocks chosen for them. Currently, Jeff suggests that we can either make the instructions very clear in terms of block option or we can provide them with a short video to guide them in the beginning.

0.4.3 Potential New Field Studies

I am also planning on reaching out to more teachers to broaden our field studies group. I will be emailing teachers that GWC have connections with as well as schools we were in contact with last semester. Due to the high number of schools that we will be reaching out to, I am currently anticipating a higher response rate this semester. This semester, we are still providing two options to teachers. They can either provide teacher-side feedback or they are choose to participate in our field study with their classroom. Therefore, even

if we can't conduct a study in their classroom, we can still gain valuable feedback from the teachers' perspective.

0.4.4 Parson's puzzle Design for Loops

From last semester, we have the pre-test and post-test that I created for loops. Therefore, I can corporate them into the surveys for the loop lessons. Also, we can use the the same Background Survey, Cognitive Load on Puzzles Survey, Cognitive Load test on Survey and Intrinsic Motivation Survey since they are lesson specific. Therefore, the main goal is to create the Parson's Puzzle for all three conditions. Hopefully, we will be able to create more meaningful distractors with loop puzzles as a sub-optimal path is more easily defined as compared to sequences.

0.4.5 Qualtrics and MLab

These are the two areas of analysis that are rather new to me. Thus, I plan to learn and analyze data from these two places meaningfully. Currently, we have all the needed surveys on Qualtrics for Sequences. However, I need to learn to navigate through Qualtrics and provide graphic interpretation on our future data. Furthermore, I would like to familiarize myself with MLab to help interpret their behaviors while solving the puzzles. This could mean, did they refresh the page during the study, or how much time they spent on placing a particular block.

0.5 Timeline

Sprint 1: Finalize Parson's Puzzle Design and Instructions
Sprint 2: Video meeting with Elissa and continue Field Study with her
Sprint 3: Analyze Data from Elissa's classroom from Qualtrics and MLab Sprint 4: Connect with larger group of teachers and continue Field Studies in different schools
Spring 5: Design Loops or Conditionals lessons for future use