SAGE Research Proposal: Spring 2021

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***Abstract*—The main purpose of this paper is to delineate the goals for SAGE in the Spring 2021 semester. In the field studies area, the main objectives include iterating on the field study data obtained in previous semesters, preprocessing the data into an easy-to-parse format for data analysis, and setting up the parameters for future field studies. In terms of the SAGE platform itself, the main objectives are Parsons Puzzle authoring and instruction clarification in the existing puzzle database.**

I. Introduction

THE objective of SAGE (Social Addictive Gameful Engineering) is to provide teachers a platform to design puzzles emphasizing computational thinking concepts for students to complete self-motivated and rewarding manner. Computational thinking (CT) can be framed as a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use. Keeping in mind that CT aims to describe how humans, not computers, think logically, algorithmically, procedurally, analytically, recursively, and creatively, the motivation behind SAGE grows clearer as a venture into a more holistic approach to computer science education. Thus, SAGE places the programmer, rather than the computer, at the forefront in its learning environment. The user experience is a key component in achieving this goal, and assessing whether the student feels at the forefront must be done through thorough field studies involving both the students and instructors. SAGE as a system cannot exist on its own without continual user feedback on each iteration as K-12 Computer Science education curriculum changes rapidly while the amount of educational resources on the web grow exponentially. Field Study 1 (FS1) concluded and was submitted for publication at the 26th annual conference on Innovation and Technology in Computer Science Education (ITiCSE) under the title Integrating Parsons Programming Puzzles with Scratch. Data collection for FS2 is currently completed, with analysis being performed this semester and used to help set up the upcoming FS3. As such, careful analysis of FS2 and an emphasis on comparing it to the attitudes present in FS1 might be helpful in conducting the upcoming FS3. One of the main goals for this semester, then, is to assess the data from field studies 1 and 2 and put this assertion to test. Some of these goals include creating protocol content for looping CT concept for FS3, finalize the condition set and any participant demographic constraints, and creating games within the platform across conditions with a gameful, thematic edge. Preprocessing the FS2 collected data to be compatible with Python scripts that can quickly parse through the data is also a priority for the beginning of the semester to ease the workload on the analysis portion. Another key feature of SAGE to improve upon this semester are the Parsons Programming Puzzles and associated instructions. We want the students to need to read the minimal amount of instructions in order to solve the puzzles, and shift the focus from instructions to clear directives. Thus, it is important to determine if any variation of instruction needed across conditions.

II. Proposal

II.i. FS2 Data Processing

FS2 data was obtained through Qualtrics and SAGE, so a primary objective is understanding the data collected within FS2, the methods for collection, and their final representations within the SAGE ecosystem. The majority of the data seems to be stored in MongoDB, Qualtrics, and SAGE, while the rest and survey responses are stored in Google Sheets files. These can be converted into cleaned CSVs with a consistent

data frame. These CSVs can then be used as inputs for Python scripts that can parse the data and give us the graphical and quantitative results that we seek to display within the upcoming papers.

II.ii. Authoring Puzzles and Instruction Clarification

After gaining feedback, we will analyze the results of the various surveys and observations we make. In turn, we will use this feedback, emphasizing the feedback from the IM survey and pre- and post-tests, to make modifications to existing Parsons Puzzles in the SAGE ecosystem as well as to author future ones. The goals for puzzles include motivating scenarios, memorable segments, providing challenges without being tricky, and leaving the user with an overall positive impression. These puzzles could best be encapsulated in iterative teaching structures, such as training for a race. For this specific example, the structure would follow:

1. Stretch/jumping-jack sequence three times
2. Run around park once (repeat until)
3. Run around park three times (nested loops)
4. Run race with trickier path (one lap, sequence, two laps)

We also need to determine if instructions need to vary across conditions. We might consider configuring the CVG condition so that explicit step-by-step instruction is not necessary, if game objective feedback offers sufficient progress and completion guidance, and move-based PPP feedback is disabled. This configuration would optionally facilitate an alternative approach to looping instruction in which the participant is encouraged to construct a sequence first, then focus on the loop. In PPPs, it is less confusing when the participant is guided to build the puzzle from top to bottom, since when puzzles are solved that way, the result is a positive flow of correctness feedback and an increasing score. The adult instruction warmup solutions provide us with the appropriate reference for this section. Functionality for game objectives needs to be implemented likewise, which is going to be at the forefront of authoring as well.

II.iii. fs3 Preparation

To prepare for fs3, it is imperative to identify additional and/or modified survey content, starting by reviewing CAS and the CS Attitude Survey. Another related task is to create questions specific to our study for final survey similar to those created for fs2 final survey. Furthermore, a study guide will be created in Qualtrics similar to the fs2 guide, but with one block per step. Protocol content for the looping CT concept for fs3 needs to be created, along with the finalization of the condition set and any participant demographic constraints. Based on the results of fs2 analysis, the data will be set up to be collected in a much more standardized and easy-to-process manner for fs3. During this time, I also plan to interview instructors who work with adult-age programming students, such as the instructors at Justice Through Code at Columbia University's Center for Justice. Cursory user-centered-design sessions will be conducted with them, with an emphasis on casual interview to obtain journey maps and pain points during the instructors' use of SAGE.

III. Timeline

Sprint	Objective
Sprint 1	Ramp-up, Environment Setup
Sprint 2	Preprocess fs2 data
Sprint 3	Puzzles, instruction clarification
Sprint 4	fs3 preparation, interviews

References

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