SAGE Midterm Report

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COMS 3998, Section 28

Spring 2019

Abstract

In this report, we describe progress and current status of work on the Survey, Field Study Design, and Publication Strategy epic in TFS. At this point, we have tentatively completed the following user stories: 342 (Pilot Field Study Design), 355 (Pilot Field Study Research Questions) and 490 (Complete Instructional Documentation and Examinations for Field Study). We discuss our current study design for both teachers and students and outline our plan for implementing SAGE features including user stories 489 (Complete Problem Set for Field Study) and 488 (Enable Partial Solutions for PPP).

Introduction

While initially intended to satisfy the Institutional Review Board (IRB) requirements, we eventually decided that having the teacher's conduct the study would not only avoid the administrative delays associated with the IRB process, but more accurately simulate the use of SAGE in the classroom; providing more realistic results and insights (external validity).

In the current iteration of the field study design, the study will be led by trained teachers that will provide general instructions to the students. Surveys will be distributed and recorded as Google Forms. Students will access SAGE and complete the appropriate (timed and untimed) exercises according to study design instructions and documentation we would provide.

Study Design

The purpose of this pilot field study is to systematically test the efficiency of SAGE PPP for teachers and students and get further feedback on system pain points in order to guide future development. Prior research has made efforts to compare levels of cognitive load and learning efficiency between different types of Parsons Puzzles or block-based programming environments (Harms, Chen and Kelleher (2016); Ericson, Margulieux and Rick (2017)). As an extension, the current study will gauge both the system's practical (teaching) effectiveness and learning efficiency of different SAGE-scratch-based tasks including **(1)** Scratch alone, **(2)** code fixing, and **(3)** PPP.

<u>Student Study</u>

The primary goal of this study would be to compare the learning efficiency of the three conditions. Learning efficiency is to be conceptualized as a combination of the cognitive load and performance such that higher efficiency is characterized by lower cognitive load and higher performance (and vice versa). The secondary goal would be gather feedback on system pain points overall and with respect to SAGE PPP.

Procedurally, there are four phases. The first phase gathers demographic data and prior programming experience information from the students. The second phase would familiarize the students with navigating the SAGE environment and the different task formats. The third phase will have students work through 4 timed exercises respective to their condition. The final phase will include a survey of user interaction with the platform and exercise as well as open ended feedback survey to gauge strong and weak points in the platform.

For each timed exercise, time for completion, cognitive load (CS LCS), and performance (whether their submission matched the solution or not) will be measured and ultimately compared, across the conditions.

<u>Teacher Study</u>

The primary goal of this study would be to compare the practical effectiveness of teaching using SAGE PPP as opposed to an instructor's current method.

Procedurally, this study will resemble a simplified version of the student study. Initially, we would gather teacher background information (including years of experience) and existing teaching-related effort, give teachers puzzle design exercises, have them rate the teaching-related effort they associate with the exercises, and provide open-ended feedback to gauge pain points from the design perspective.

From there, we would compare teaching-related efforts between the puzzle design and their existing methods.

Limitations and Future Work

One of the conditions for the field study requires the use of a partial solutions which would allow students to fix given code blocks in SAGE. This feature is currently not implemented in SAGE, and hope to move forward with its implementation once our study design is finalized.

Within the familiarization phase, students completed guided puzzles to become more familiar and comfortable using the SAGE environment. This puzzles require an ability to show the output or resulting animation from correct code. With the media restrictions of SAGE, these solutions or examples could be provided as gifs or screenshots within the instructions, but may cause confusion for participants.

With the bulk of the study design completed, we hope to finalize both the teacher and student studies soon. As a result, support materials including exercises, surveys, and new SAGE features need to be completed. Most critical work for the future is adding the necessary functionality to support partial solutions for the code fix condition.

[Demographic Survey](#)

[SAGE Design Survey](#)

[Open Ended Questions](#)