

# Final Report

## Parson's Programming Puzzles: Optimizing Efficiency and Investigating the Effects of Feedback

Further research on Social Addictive Gameful Engineering (SAGE) design  
and computational thinking (CT)

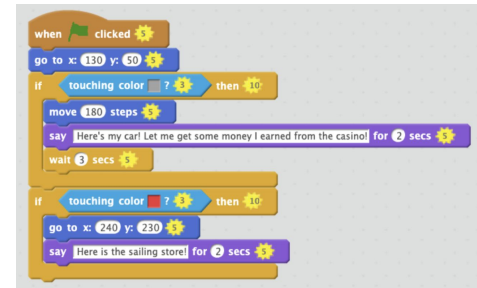
Spring 2021  
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# Overview

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  - a. Cognitive Load
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# Related Research

1. Integrating Parsons Programming Puzzles with Scratch
2. Parson's Programming Puzzles: A Fun and Effective Learning Tool for First Programming Courses
3. Lessons Learned from Available Parsons Puzzles Software
4. Measuring Cognitive Load in Introductory CS: Adaptation of an Instrument
5. Instructional Efficiency: Revisiting the Original Construct in Educational Research



# Study Purpose

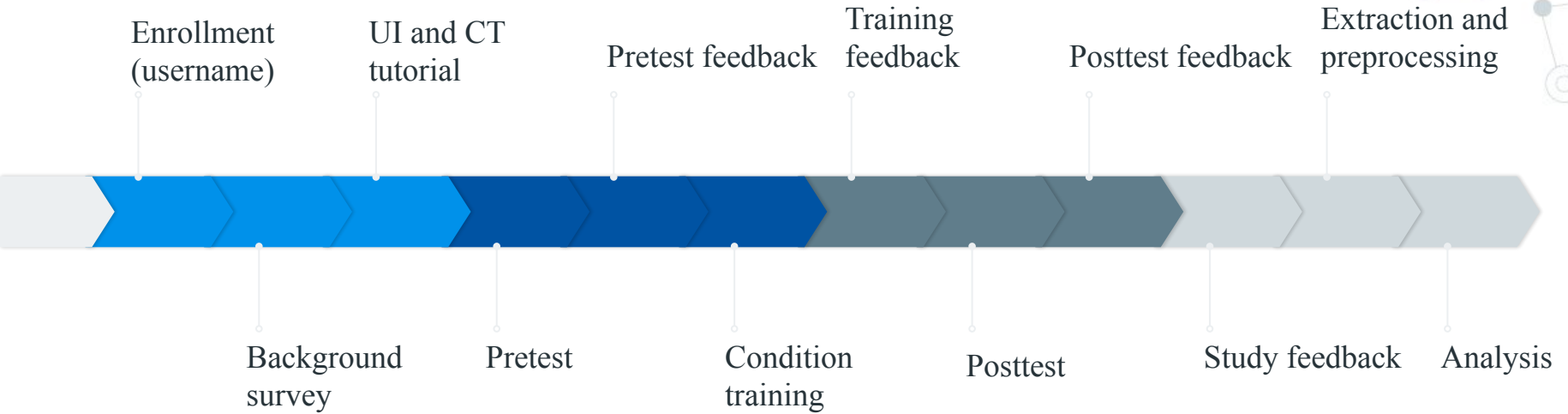
Number	Type	Name	Game Type
1	PPP+f	Let's go sailing! (A)	parsons
2	PPPd+f	Let's go sailing! (B)	parsons
3	ScratchIE+f	Let's go sailing! (C)	parsons (no palette)
4	ScratchIEd+f	Let's go sailing! (D)	parsons (no palette)
5	PPP-f	Let's go sailing! (A2)	parsons (no feedback)
6	PPPd-f	Let's go sailing! (B2)	parsons (no feedback)
7	ScratchIE-f	Let's go sailing! (C2)	parsons (no feedback no palette)
8	ScratchIEd-f	Let's go sailing! (D2)	parsons (no feedback no palette)
9	PPP+f	Your very first recipes! (AC)	parsons

1. Fs1/SAGE validation

2. Cognitive Load,  
Efficiency, Performance,  
Motivation

3. Demographics

# Methods




# Results: Cognitive Load

1. After Pretest (Survey 03)
2. After Puzzle (Survey 04)
3. After Posttest (Survey 06)

Test Statistics <sup>a,b</sup>				
	Intrinsic Load	Germaine Load	Overall Cognitive Load	Extraneous Load
Kruskal-Wallis H	24.554	3.845	24.818	20.305
df	7	7	7	7
Asymp. Sig.	.001	.797	.001	.005

# Results: Performance



	PRE - POST
Z	-2.735 <sup>b</sup>
Asymp. Sig. (2-tailed)	.006

**Figure 6.2:** Sample output for Wilcoxon Signed Ranks Test indicating a significant difference in transfer performance for groups 1-8.

	PRE - POST
Z	-1.029 <sup>b</sup>
Asymp. Sig. (2-tailed)	.303

**Figure 6.3:** Sample output for Wilcoxon Signed Ranks Test indicating no significant difference in transfer performance for group 9.

# Results: Efficiency

$$E_{instructional} = \frac{Z_{P_{test}} - Z_{E_{learning}}}{\sqrt{2}} \quad E_{performance} = \frac{Z_{P_{test}} - Z_{E_{test}}}{\sqrt{2}}$$

Test Statistics <sup>a,b</sup>				
	Performance Efficiency (time based)	Performance Efficiency (CL based)	Instructional Efficiency (time based)	Instructional Efficiency (CL based)
Kruskal-Wallis H	4.721	7.264	40.215	14.808
df	7	7	7	7
Asymp. Sig.	.694	.402	.000	.039

Figure 6.4: Sample Kruskal Wallis H test efficiency output.



# Results: Motivation

1. TEQ Results
2. Individual quantifiers
3. Expanding fs1 results to further conditions

Programming is...	PPP	PPP-distractor	limited-constraint-feedback
Positive Shifts			
something I've wanted to learn	M=-0.19, SD=1.40	M=0.27, SD=1.31	M=0, SD=1.19
fun	M=0.74, SD=1.67*	M=0.40, SD=1.74	M=0.36, SD=1.43
enjoyable	M=0.90, SD=1.83*	M=-0.05, SD=1.68	M=0.68, SD=1.76*
important to know	M=0.25, SD=1.48	M=-0.05, SD=1.17	M=0.09, SD=1.19
easy to start	M=1.35, SD=2.29*	M=0.68, SD=1.13*	M=0.45, SD=1.71
something that takes practice	M=0.065, SD=1.09	M=0.05, SD=1.29	M=-0.32, SD=1.17
Negative Shifts			
too difficult to understand	M=-1.48-, SD=2.03**	M=-0.77, SD=1.77	M=-0.64, SD=1.89
boring	M=-0.41, SD=1.6	M=-0.32, SD=1.17	M=-0.54, SD=1.90
a foreign concept	M=-1.13, SD=1.83*	M=-0.27, SD=1.55	M=0, SD=2.07
too time consuming	M=-0.35, SD=2.09	M=-0.09, SD=1.27	M=-0.09, SD=2.44

# Discussion

1. Significance of performance and instructional efficiency findings
2. Efficiency support for related work
3. Informing fs3 study design
  - a. Sample size, pipeline, conditions
4. Key points for SIGSCE submission

# Further Work



1. Fs1 revisions



2. Fs3 design



3. Fs2 writeup (SIGSCE technical symposium)



4. Additional analysis

a. Demographics

b. Grouped comparisons (training element, puzzle type, etc.)

# References

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