Statistician's Mission

Virtual Interactive Curriculum

Team 5
IE Capstone

Our Team

Heather Cheung
B.S. Industrial Engineering
M.S. Engineering Management

Matt Hadeka
B.S. Industrial Engineering
Minor: Healthcare System Operations

Jahaan Saini
B.S. Industrial Engineering
M.S. Human Factors Engineering
Minor: Entrepreneurship

Lianna Schuele
B.S. Industrial Engineering
M.S. Engineering Management
Minor: Mathematics

Our Sponsor

HSyE

Northeastern University

Healthcare Systems Engineering Institute

Dr. James Benneyan

Director, Healthcare Systems Engineering Institute

Problem & Background

Goal

Convert common quality control teaching exercises from in person to virtual educational modules

Problem

Modules have historically been conducted via in-person facilitation. Existing virtual versions lack instruction, feedback & evaluation

Scope

Develop, test & iterate learning modules and create sustainability plan for project handoff

End-Users & Purpose

End-Users

Students and professionals with limited statistical thinking knowledge

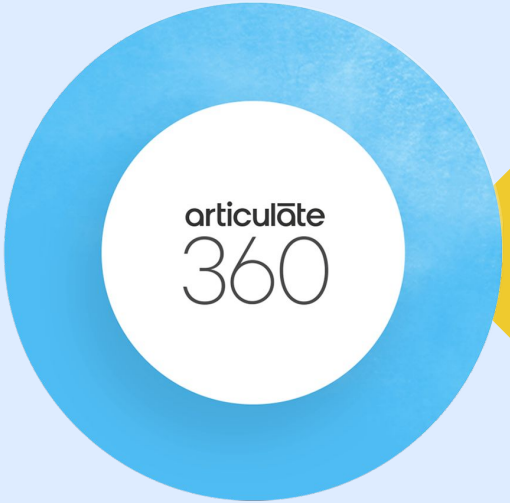
Purpose

To teach statistical process improvement techniques and how to apply them via streamlined interactive simulation

Solution

Final E-Learning Curriculum

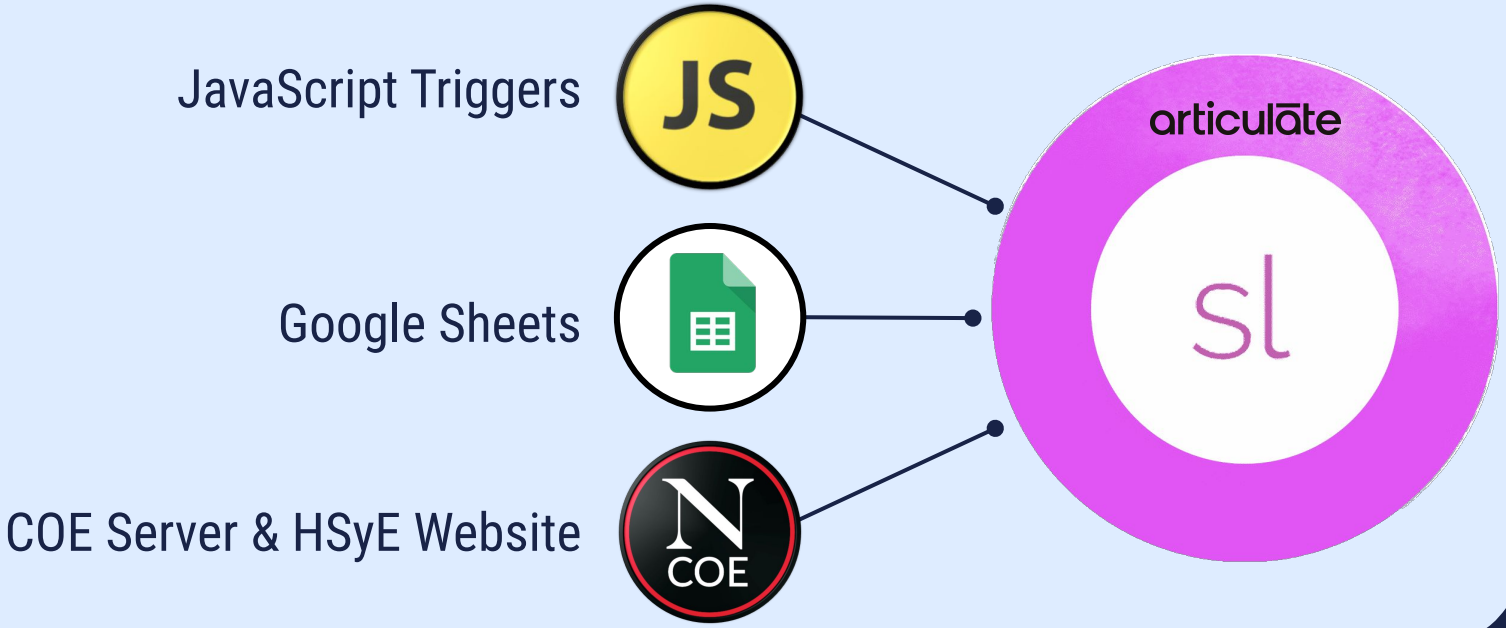
Software Selection



Key Features

- Broad suite of tools to support user interactivity
- Robust assessment system
- Ability to integrate traditional JavaScript code

Solution Composition



Back-End Design and Logic

1. W. E. Deming's Red Beads

Binomial Random Number Generation

2. Dice Flow Variance

Systematic Trigger Logic for Value Assignment

3. Lloyd Nelson's Process Tampering

Explicit Object Positioning

Evaluation of Solution

Iteration, Analysis, & Impact

Curriculum Iteration

Expert Consultations

Subject Matter Experts and Design Review Process

Pilot Test

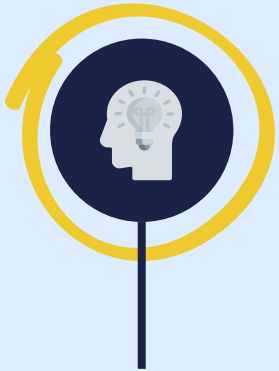
Prof. Martinez's Quality Assurance Class

Beta Test

Working Professionals Healthcare Industry Focus

Key Performance Indicators

Success of the curriculum was assessed based on the following:



Content Understanding

User Empowerment

Course Length

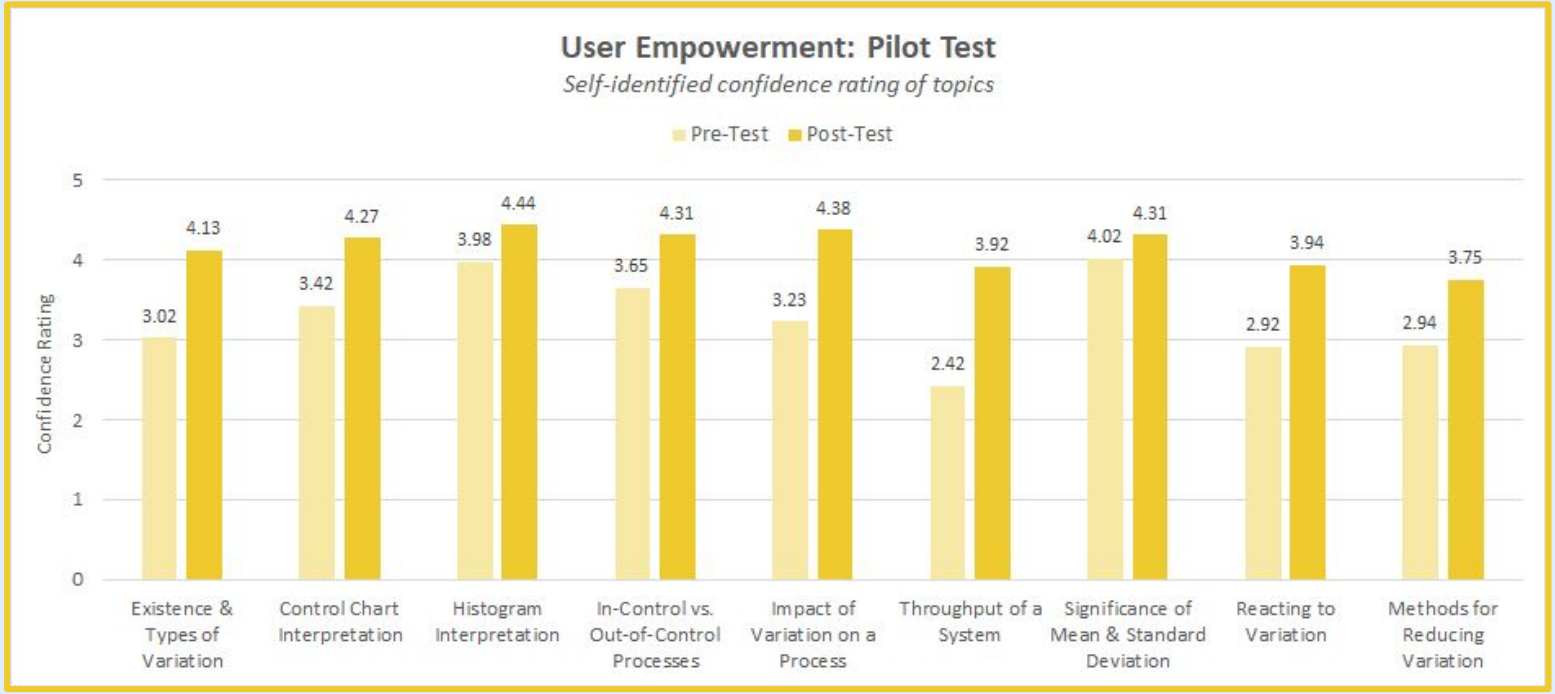
Module Effectiveness

1 Content Understanding

t-Test: Two-Sample Assuming Unequal Variances		
Content Understanding		
	Pilot	***Beta***
Mean	12.6387	18.5333
Variance	10.9753	5.9809
Observations	47	15
Hypothesized Mean Difference	0	
df	32	
t Stat	-7.4138	
P(T<=t) one-tail	**9.78E-09**	
t Critical one-tail	1.6938	
P(T<=t) two-tail	1.96E-08	
t Critical two-tail	2.0369	

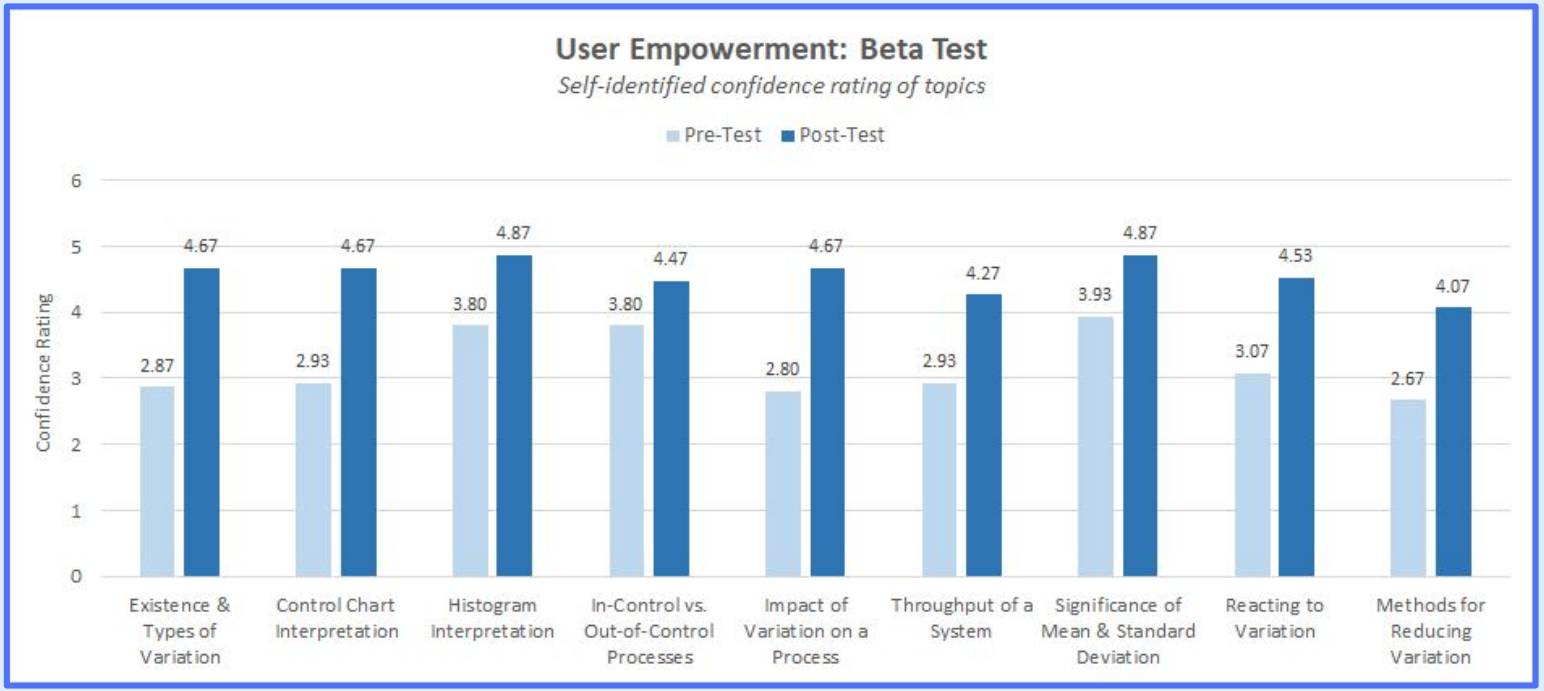
Average score on post-test questions (out of 20 points total)

2 User Empowerment



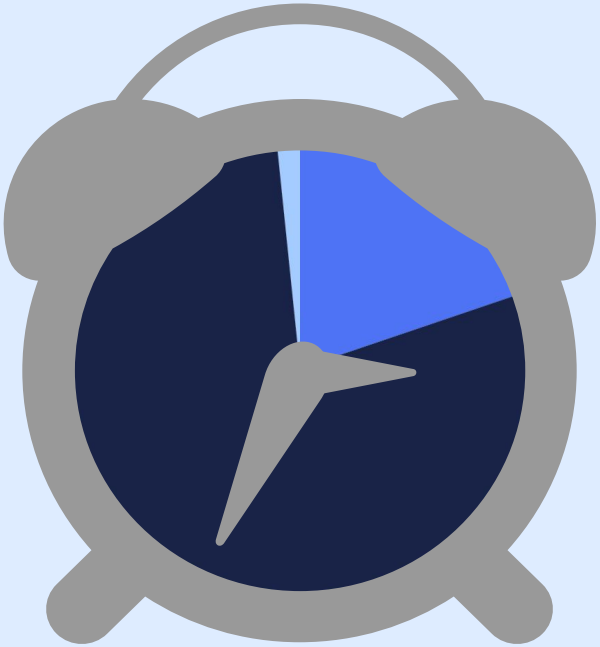
P-values:	5.665E-10	1.766E-06	5.982E-04	1.913E-04	4.040E-7	2.553E-10	1.072E-02	1.856E-06	1.392E-05

2 User Empowerment



P-values:	8.440E-05	1.807E-04	1.063E-03	2.698E-04	5.157E-04	4.725E-03	1.054E-04	2.229E-04	8.636E-04

3 Course Length



< 30 Minutes

30 - 60 Minutes

60 - 120 Minutes

Compared to the baseline of ***3 hours*** during in-person facilitation

4 Module Effectiveness

Category	Mean Pilot Test Rating	Mean Beta Test Rating
Usability	4.37	4.55
Design	4.32	4.54
Learning Objectives	4.54	4.62

Tracking against a goal rating of ***4 out of 5***

Future Work

- Catapult framework
- Industry-specific courses
- Various difficulty levels
- Sounds & voice over
- Multi-player version

Thank You!

Questions?

IE Capstone Team 5
Heather Cheung, Matt Hadeka, Jahaan Saini, Lianna Schuele

Appendix

Exercise Descriptions

DEMING'S RED BEADS

A training tool that Deming used to teach his 14 Obligations of Management; the exercise is to have each worker scoop one time and try to fill all the holes in the paddle with white beads.

DICE FLOW VARIANCE

An exercise that involves rolling dice in multiple scenarios with different scoring rules to simulate environments in which the mean increases and standard deviation decreases. By analyzing the score data, the consequences of variation can be visually mapped and understood.

LLOYD NELSON'S FUNNEL

A simple apparatus that has a moveable funnel suspended over a grid. When a ball is dropped through the funnel it strikes the table and leaves a mark. If 100 balls are dropped without changing the funnel placement, a fairly tight group of marks can be expected.

GEORGE BOX'S CATAPULT

A catapult is used to produce variation in output distances for different sized projectiles, input angles, and other variables. Plotting the results can reveal the strength of effect that each variable has on the output.

Learning Objectives

1. W. E. Deming's Red Beads

Existence and types of variation

2. Dice Flow Variance

Consequences of variation

3. Lloyd Nelson's Process Tampering

Reacting to variation

IE Tools

- Software Selection Decision Matrix
- Human-Machine Interaction (UX)
- Design Reviews
- DMAIC Process for Iteration
- Poka-Yoke
- Standard Operating Procedures

Software Selection Decision Matrix

Criteria	Weight	Visualization Software: Weighted Decision Matrix							
		Full Stack Development		Articulate		Knowbly		Elucidat	
		Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Functionality	5	4	20	4	20	4	20	5	25
Usability	5	4	20	5	25	3	15	4	20
Interactive	5	3	15	5	25	4	20	5	25
Build Difficulty	4	1	4	4	16	5	20	3	12
Scalability	4	5	20	4	16	2	8	4	16
Accessibility	3	4	12	4	12	5	15	3	9
Cost	2	5	10	3	6	4	8	1	2
Training & Support	2	3	6	5	10	4	8	4	8
Total		107		130		114		117	

Software Selection Criteria

Selection Criteria	Description	Weight (1-5)
Functionality	What features does the software include and how does it contribute to the overall functionality?	5
Usability	How user-friendly and intuitive of a user design can be created?	5
Interactive	How dynamic and interactive can the models be created?	5
Build Difficulty	How challenging and time-consuming will the build process be?	4
Scalability	How easily can the final product be further developed? Are there any hard limitations?	4
Accessibility	How accessible is the product across a wide range of platforms and devices?	3
Cost	What is the total cost that will be incurred including licensing, training, etc.?	2
Training & Support	How robust is the existing training and support system for users and designers?	2

Subject Matter Experts

Basma Bargal

Graduate Research Assistant
Teaching Assistant for Quality Assurance

Nicole Nehls

Research Coordinator for Healthcare Systems Engineering Institute (HSyE)

Dr. Jaeger-Helton

Director for
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Dr. Gordon Schiff

Quality and Safety Director for the Harvard Medical School Center for Primary Care

Fran Griffin

Quality Improvement Expert Working in Healthcare

Michael Pugh

In-Person Module Facilitator at Institute for Healthcare Improvement