

Analysis of Student Usage of Online Interactive Simulations

Kyle Branch

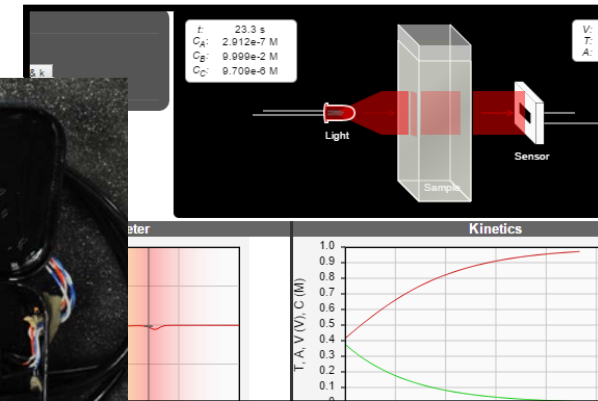
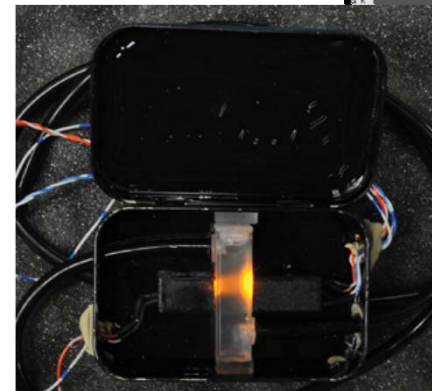
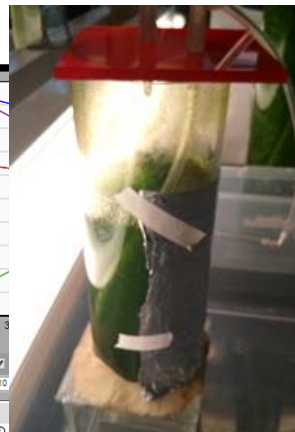
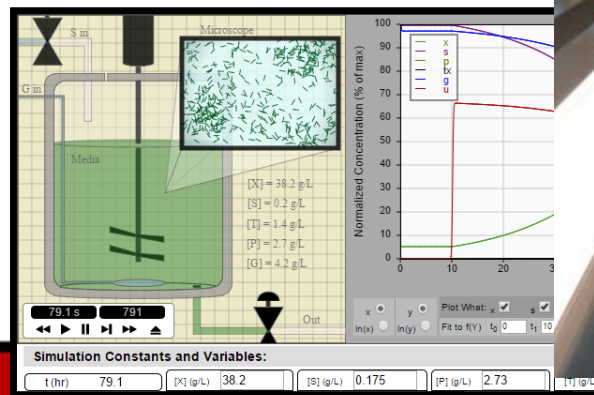
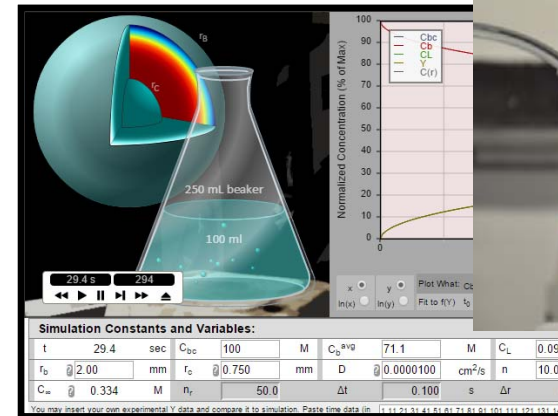
Anthony Butterfield

University of Utah

AIChE Annual Meeting
Atlanta, November 20, 2014

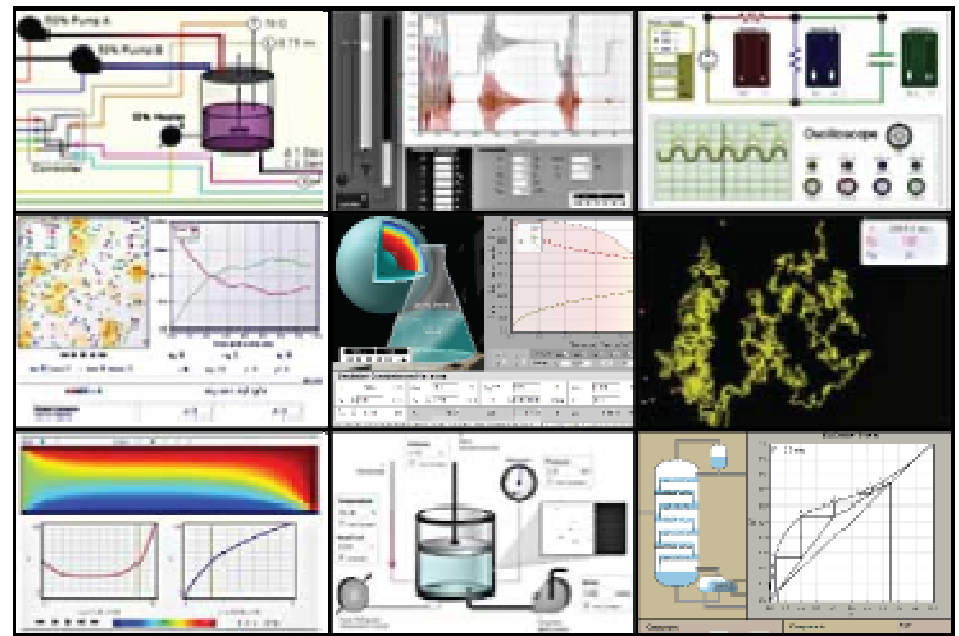
Our Simulations

- Simulate lab experimentation
- Coupled with hands-on projects
 - Used in our freshman and senior laboratory courses
 - Soon to be implemented in our mid-curriculum courses



Features of Our Simulations

- Cover a wide variety of chemical engineering disciplines
- Open-source
 - Freely accessible
- Browser-based
 - Easy to access
 - Chrome, IE, Firefox, Safari
 - PC, tablet, phone
- HTML, JavaScript, PHP
 - No download necessary



Benefits to Students and Instructors

- Saves lab time and resources
- Get a realistic sense of how adjusting parameters affect the system
- Students can move at their own pace
- Automatically graded assignments
- Students “gain experience”, and “level up”
- Track students’ usage for further optimization
 - IRB approved

RESULTS		
Your Stoichiometric Coefficient on A	=	2
Correct Stoichiometric Coefficient on A	=	2
Percent Error	=	0.00%
Total Error	=	0.0%
Max Error	=	5.0%
Correct Within Error. Good Job!		
Reset Applet?		
Results for Kyle Branch successfully recorded in database.		
See All Your Recorded Use Data		

CONSTANTS		
Chemical	=	Random
Concentration of A (M)	=	1.001e-5
Max Molar Extinction Coefficient (1/M/cm)	=	1.32e4
Primary Wavelength of the Light (nm)	=	720
Power of the Light Source (%)	=	50.0
Voltage at 100% Transmittance (V)	=	3.32
Cuvette Width (cm)	=	2.20
Initial Concentration of A (M)	=	0.0000410
Initial Concentration of B (M)	=	0.0200
Stoichiometric Coefficient on B	=	2.00
Reaction Rate Constant (1/M ^(α+β-1) /s)	=	1.50e6

Tracking Student Usage

Records

- Which student
- Correct or incorrect
- Time and location of each event
 - Mouse movements, clicks, typing
- Submission time
- All constants
- Browser, IP address, and Operating System

We can determine

- Time of day/day of week
- Time spent
- Time between clicks
- Number of clicks
- Time early/late
- Attempts required
- On campus
- Order of problems

Preliminary Analysis

	Attempts Required	Attempt Sequence	Time Early/Late		Number of Clicks	Time Between Clicks	Time Spent	Time of Day	Day of Week	Order	Percentile	On Campus	Logged In
Correct													
Logged In													
On Campus													
Percentile													
Order													
Day of Week													
Time of Day													
Time Spent													
Time Between Clicks													
Number of Clicks													
Time Early/Late													
Attempt Sequence													

- - Key - -

Not Analyzed

Not Enough Data

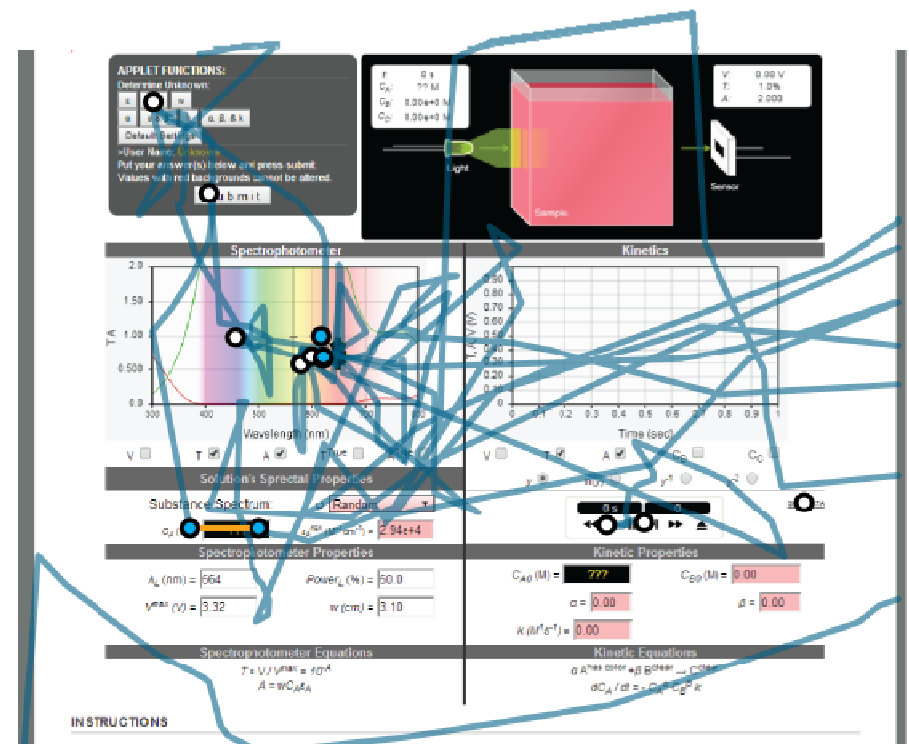
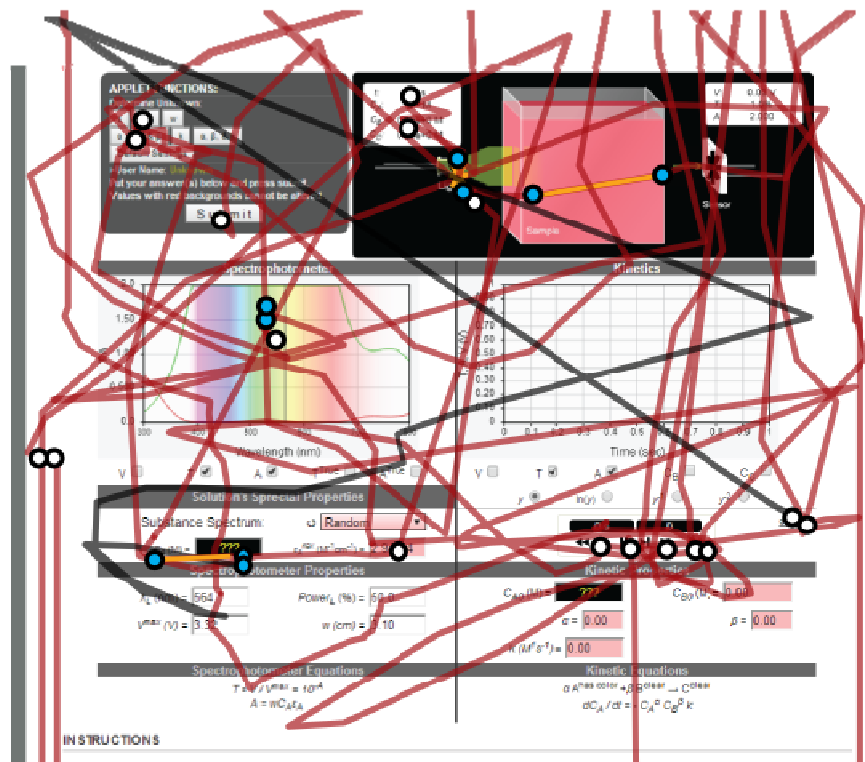
Unsure How to Analyze

Unlikely Significant

Possibly Significant

Likely Significant

Improve Simulation Interface

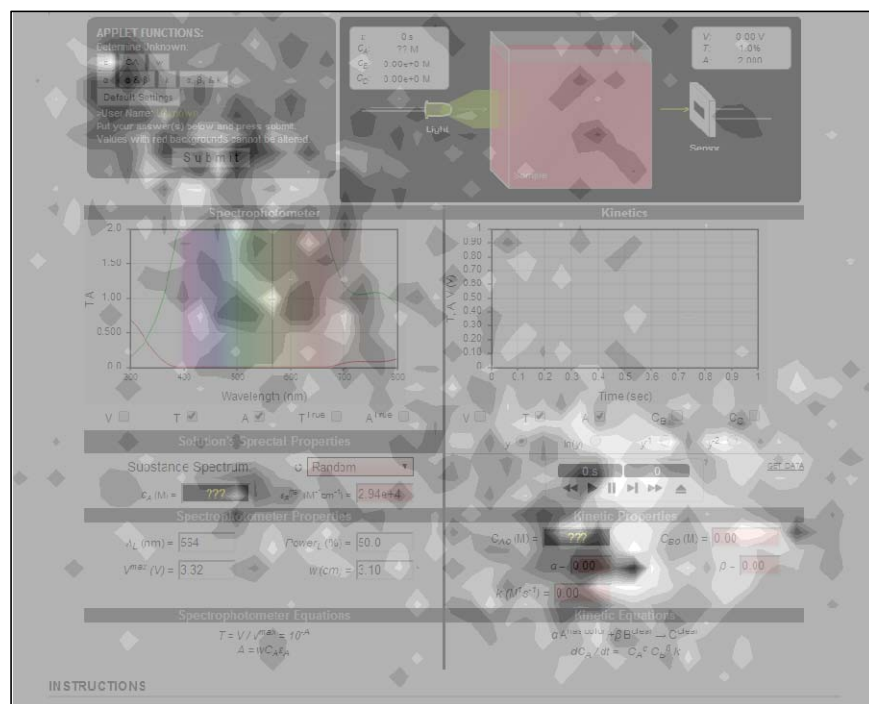


Misunderstanding of Material

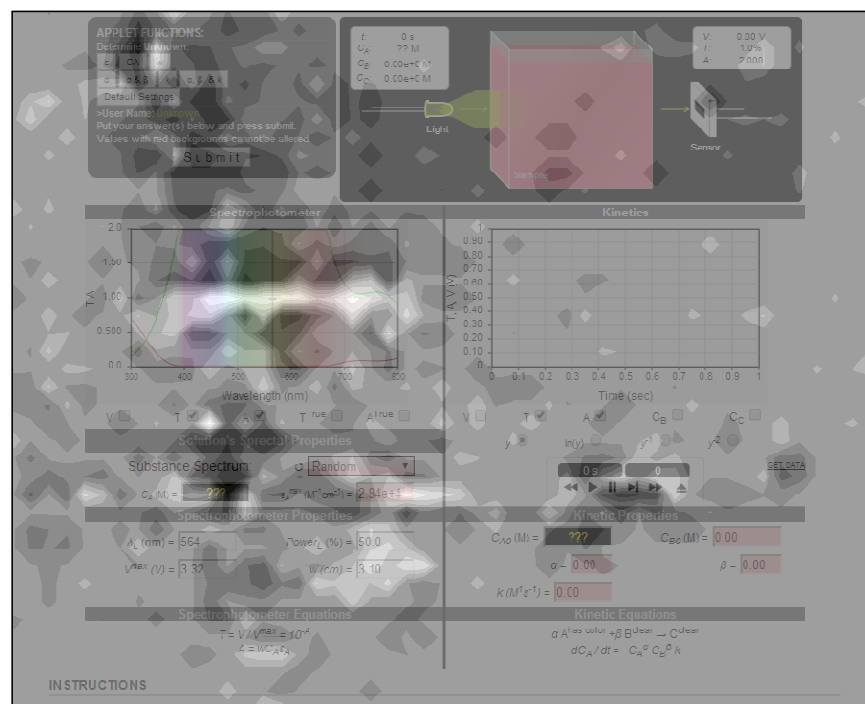


Misunderstanding of Material

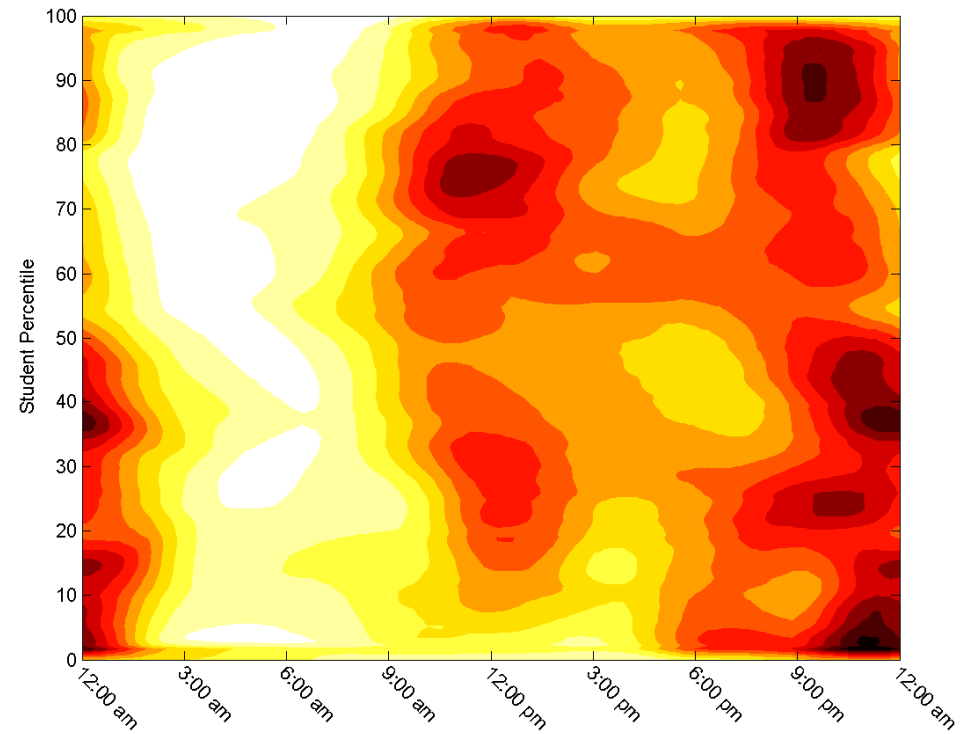
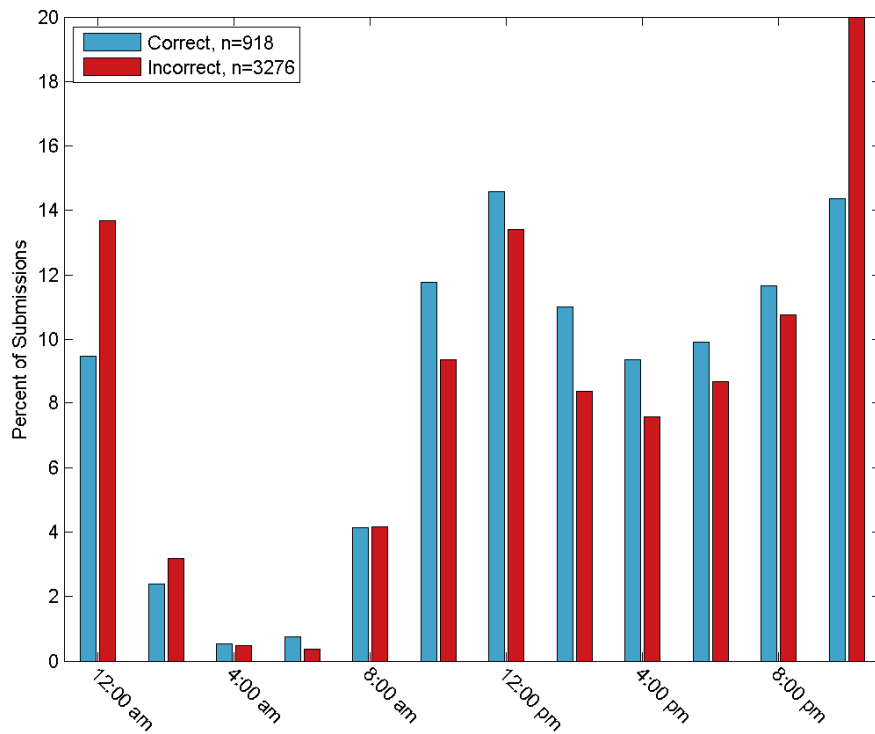
Reaction Order



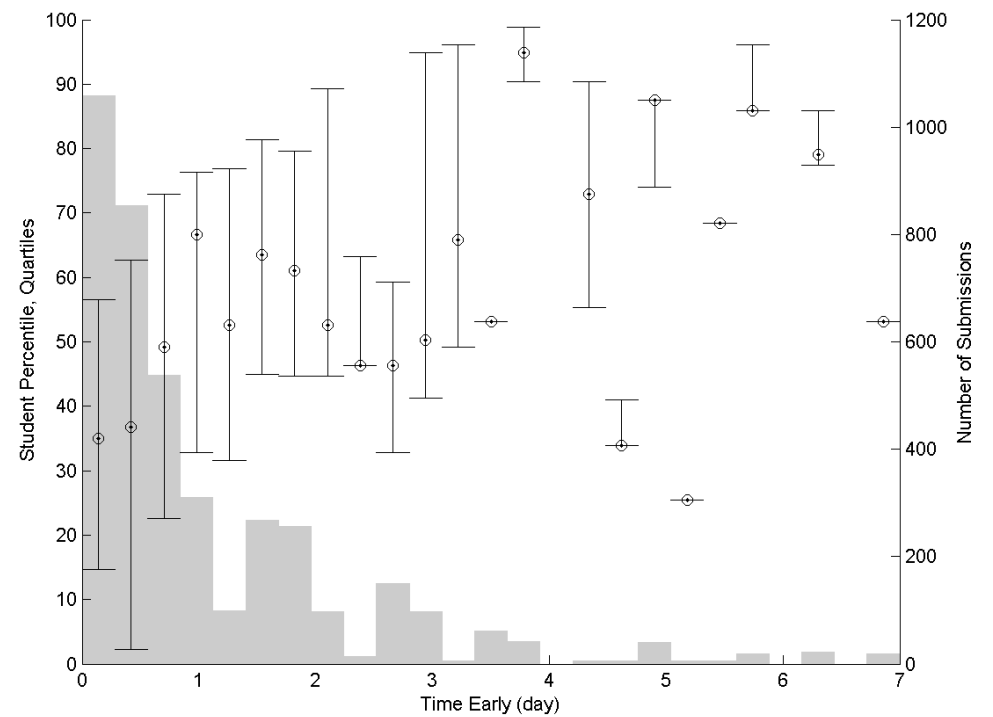
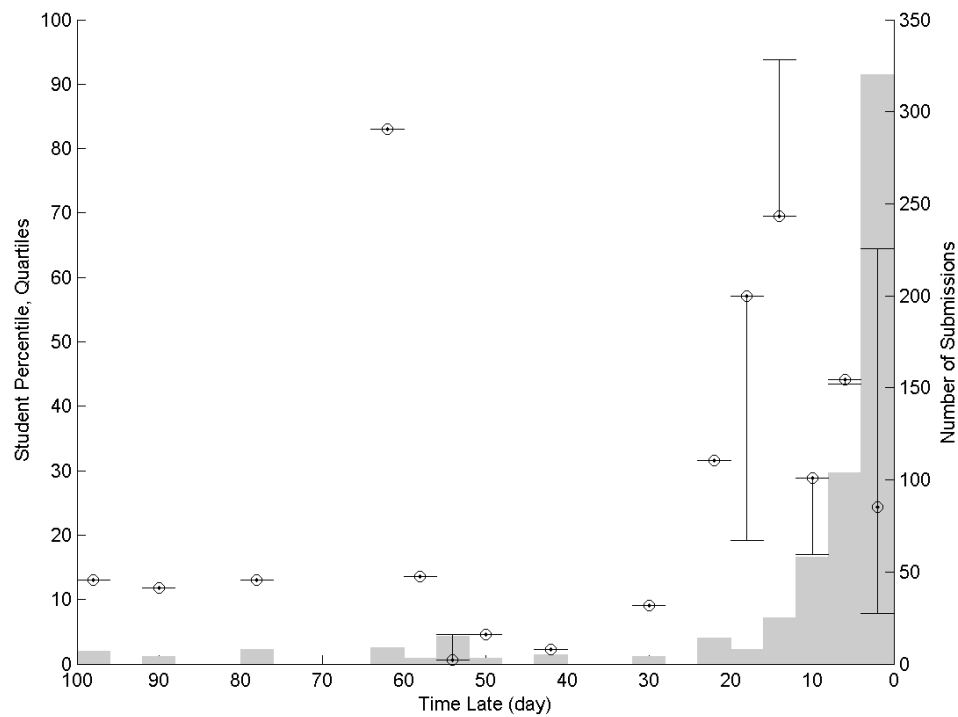
Maximum Molar Extinction Coefficient



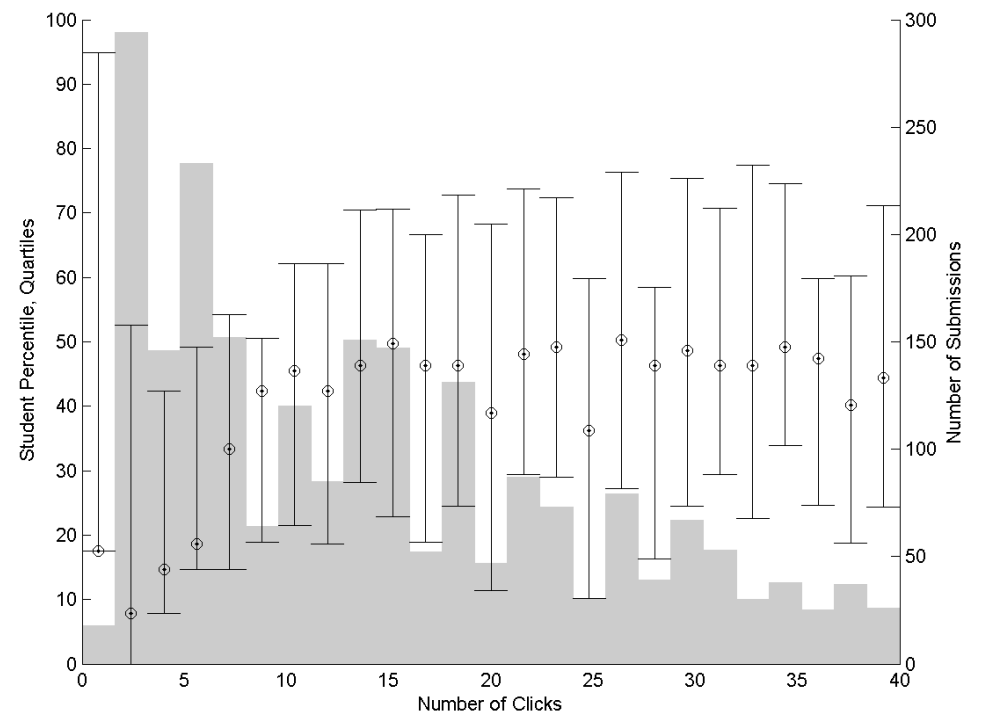
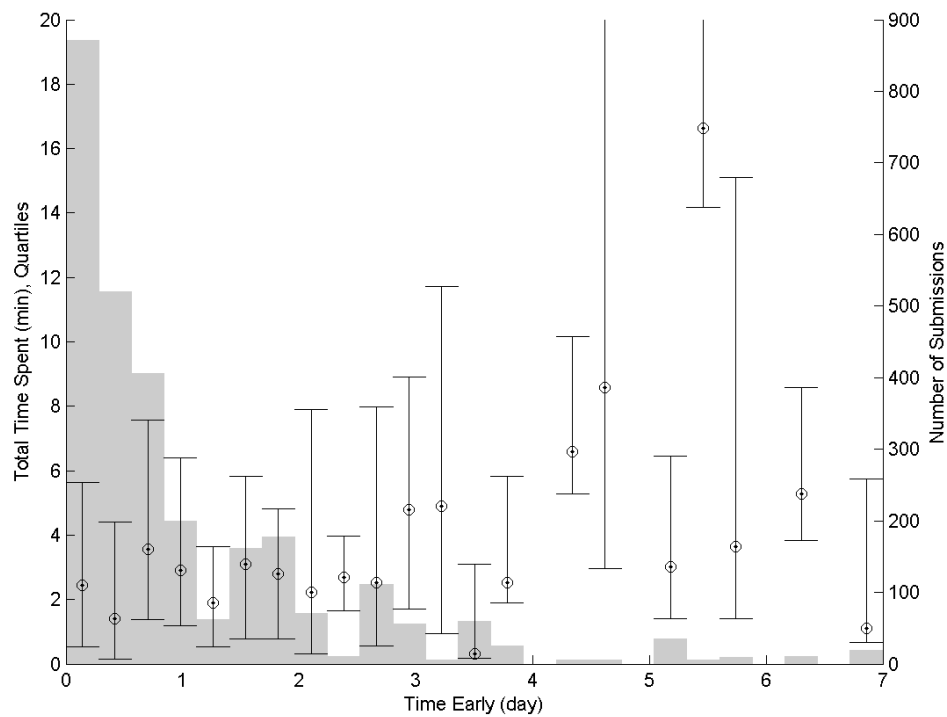
Determine Successful Behavior



Determine Successful Behavior



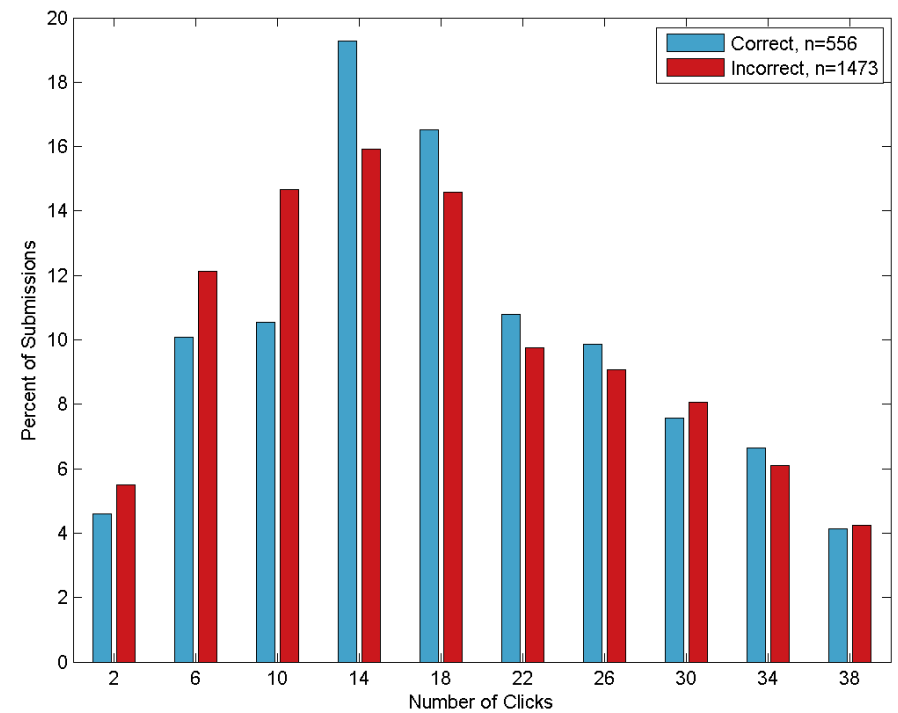
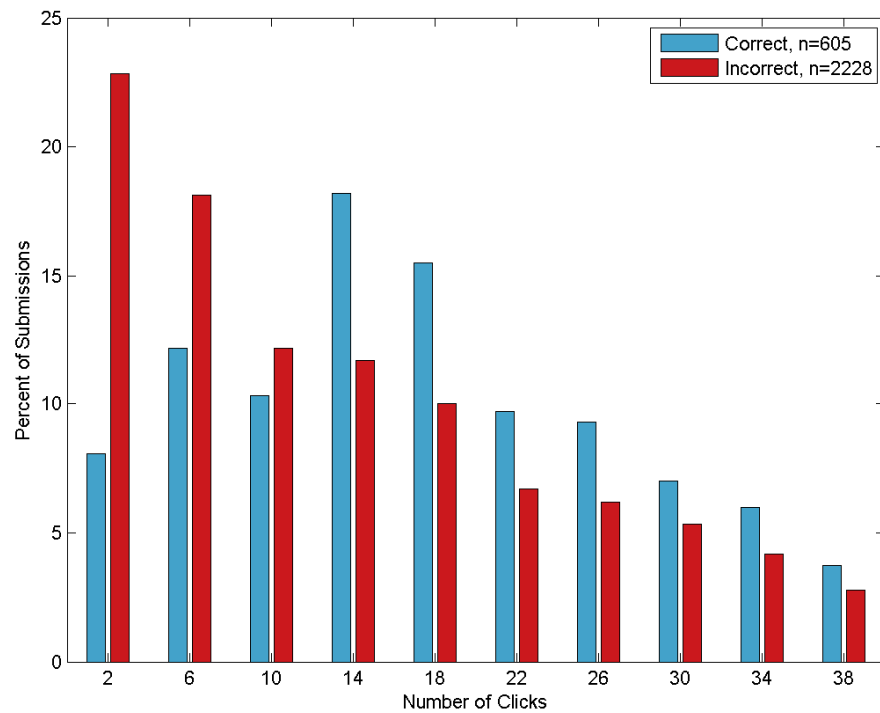
Determine Successful Behavior



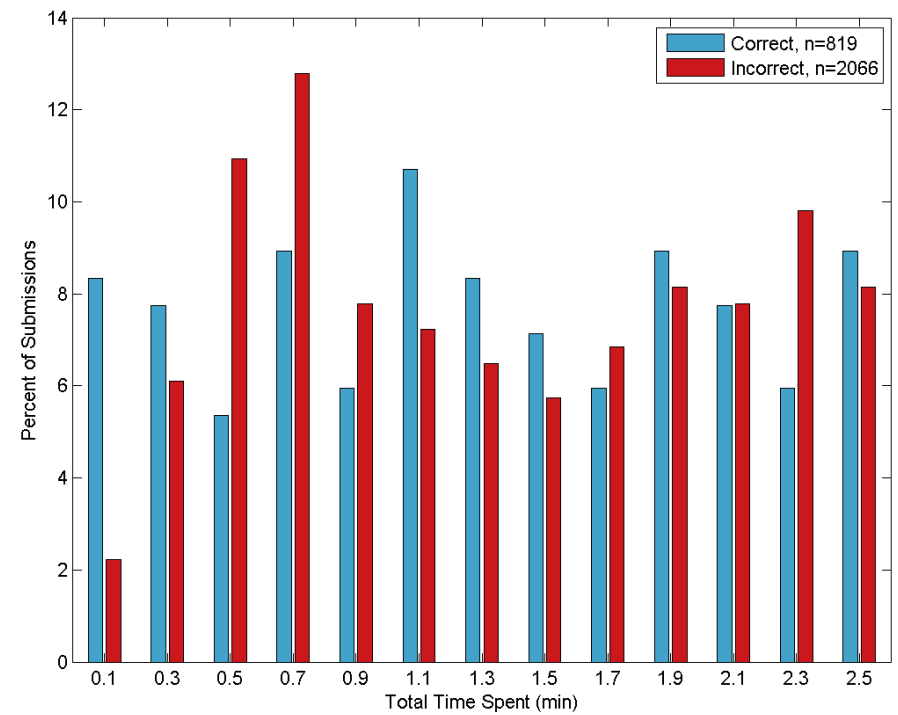
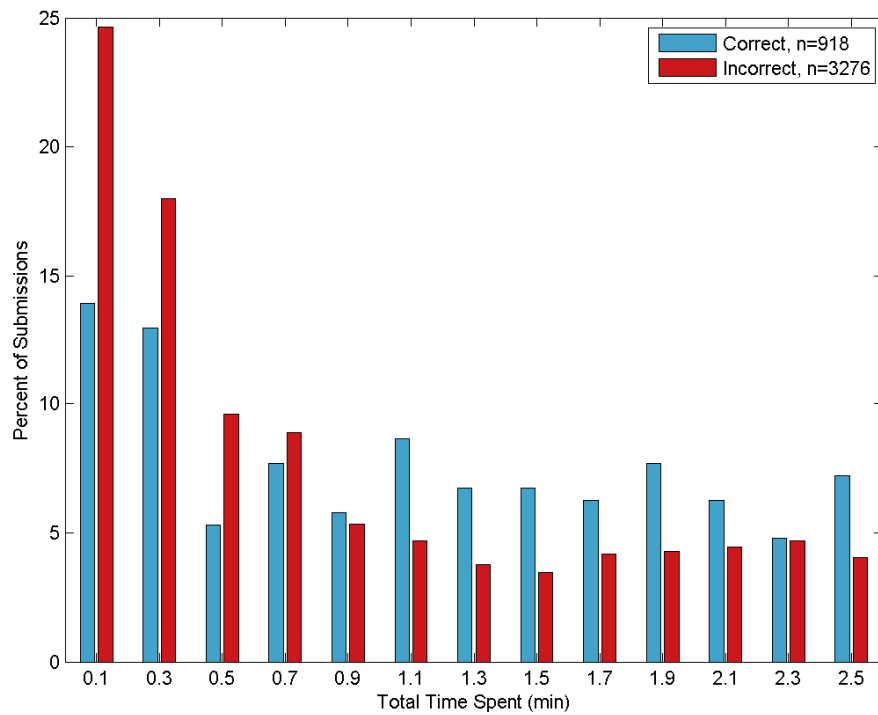
Eliminate Student Guessing

- Less than 20 sec
- Less than 6 clicks
- More than 5 attempts
- Guessing the same answer, or the previous correct answer
- Guessed before

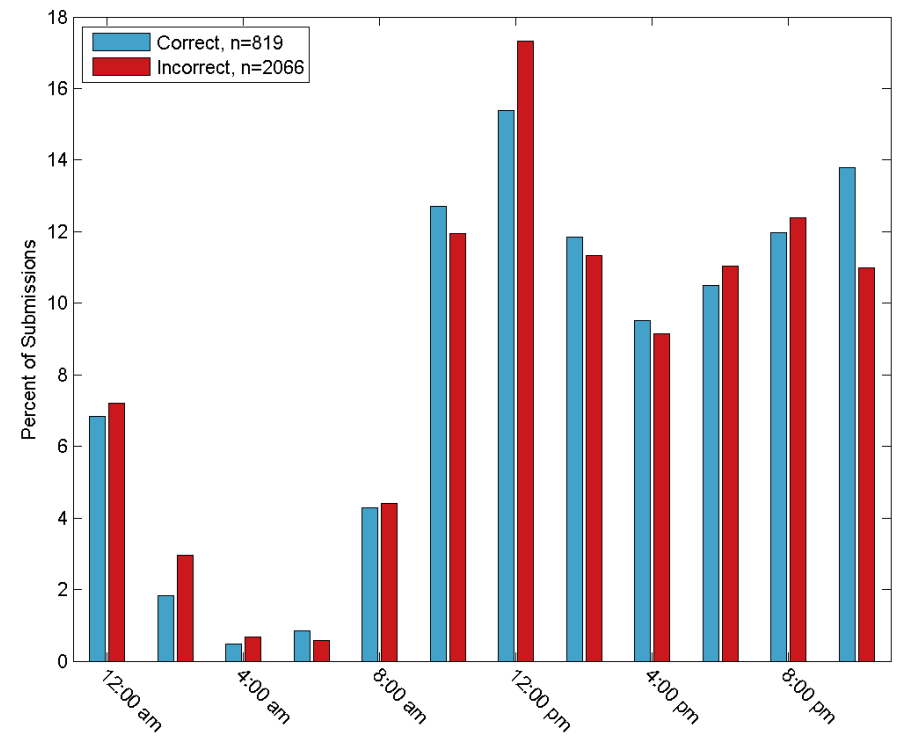
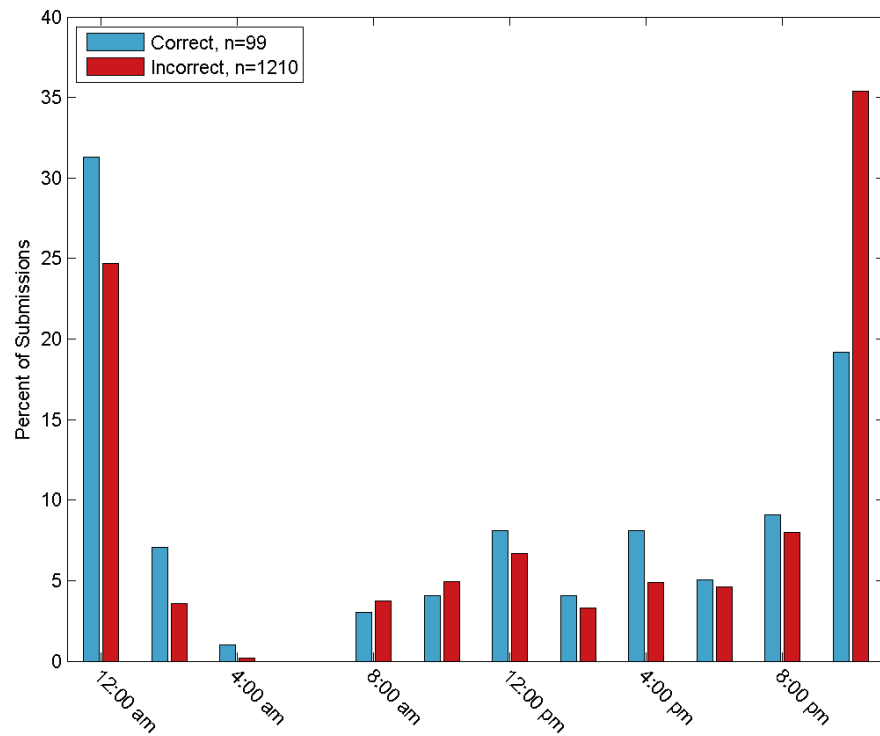
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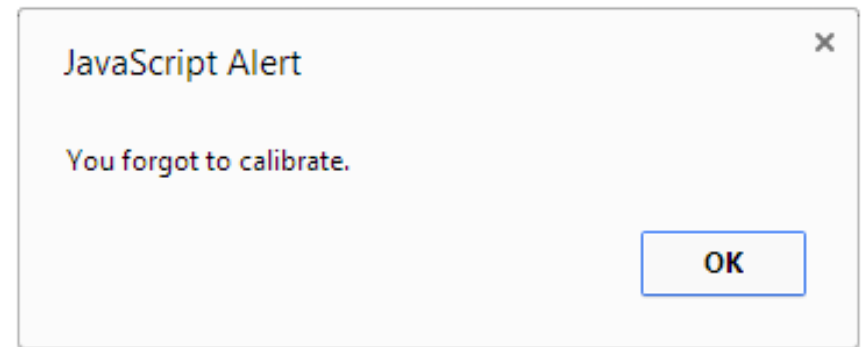


Eliminate Student Guessing



Add Automated Interventions

- You're not logged in, are you sure you want to submit your answer?
- You forgot to calibrate.
- Double check your units.
- You seem to be clicking more than necessary.
- Worked examples
- Screencasts



Questions?

Potential of Tracking Student Usage

- Add simulation functionality
- Determine students' misunderstanding of material
- Determine successful behavior
- Eliminate student guessing
- Add automated feedback