Implementing a Flipped Classroom and Active Learning Techniques in General Chemistry to Augment Student Success at a Mid-Sized Rural University

Michael R. Smith[a], Ricardo A. Aguilar[b,], Vivien L. Cherrette[a], Ami L. Rose[a], Joshua Crane[a], Charlotte Park[a], Emily Bladorn[a], Harrison Mills[a], Sisarie Sherry[a], Courtney J. Chatha[a], Heejune Park[a], Hannah Dailey[a], Robin A. Donatello[b,*], Erik C. Wasinger[a,*]

[a]Department of Chemistry and Biochemistry, California State University, Chico, [b]Department of Mathematics and Statistics, California State University, Chico

(ewasinger@csuchico.edu; rdonatello@csuchico.edu)

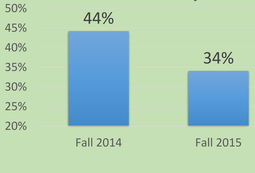
Introduction

Incorporation of a flipped classroom and active learning techniques have been shown to improve student success in undergraduate chemistry courses. On the basis of low student success rates, we have entirely reimagined our general chemistry classroom with the Course Redesign with Technology (CRT) Program through the California State University Chancellor's Office:

- Content delivery is achieved using locally produced videos;
- Class time incorporates more active learning techniques;
- UMKC Supplemental Instruction (SI) has been implemented.

Fall '14: Traditional

	DFW rate	URM DFW	nURM DFW	URM AG	FG DFW	nFG DFW	FG AG	Pell DFW	nPell DFW	Pell AG	M DFW	W DFW	Gender AG
Fall 2014	44%	56%	40%	16%	46%	43%	3%	49%	40%	9%	49%	38%	11%



Traditional Lecture:

- Historically, our general chemistry classrooms have low success rates with a lecture format.
- Students receiving D, F, or unauthorized withdrawal (DFW) rates among students in the Fall 2014 general chemistry class reached a high of 44%.

Changes

- Interventions
  - Move 90% of the content taught in class to locally produced videos;
  - Use class time for active learning methods patterned after University of Missouri Kansas City Supplemental Instruction;
  - Utilize metacognitive activities to help student think about the learning process.
- Goals
  - Reduce DFW rate by 50%;
  - Reduce at-risk student achievement gaps to <5% in accordance with Chancellor's Office 2025 Graduation Initiative;
  - Investigate the effectiveness of both CRT and SI in the classroom.

Fall '15: Course Redesign

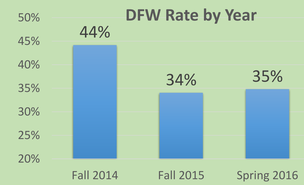
	DFW rate	URM DFW	nURM DFW	URM AG	FG DFW	nFG DFW	FG AG	Pell DFW	nPell DFW	Pell AG	M DFW	W DFW	Gender AG
Fall 2014	44%	56%	40%	16%	46%	43%	3%	49%	40%	9%	49%	38%	11%
Fall 2015	34%	47%	26%	21%	43%	27%	16%	43%	26%	17%	32%	37%	5%

First semester of implemented Course Redesign with Technology (CRT):

- DFW rate dropped by 23% compared to Fall'14.
- Achievement gaps remained in most cases, and even *increased* for Pell eligible and first generation students.

Spring '16: Course Redesign

	DFW rate	URM DFW	nURM DFW	URM AG	FG DFW	nFG DFW	FG AG	Pell DFW	nPell DFW	Pell AG	M DFW	W DFW	Gender AG
Fall 2014	44%	56%	40%	16%	46%	43%	3%	49%	40%	9%	49%	38%	11%
Fall 2015	34%	47%	26%	21%	43%	27%	16%	43%	26%	17%	32%	37%	5%
Spring 2016	35%	43%	28%	15%	47%	23%	24%	42%	29%	13%	39%	33%	6%

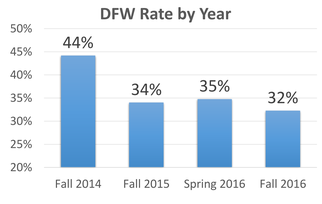


Second semester of implemented Course Redesign with Technology (CRT):

- DFW dropped by 21% compared to Fall'14, consistent with Fall'15 results.
- Increase in achievement gaps remained from Fall'15.

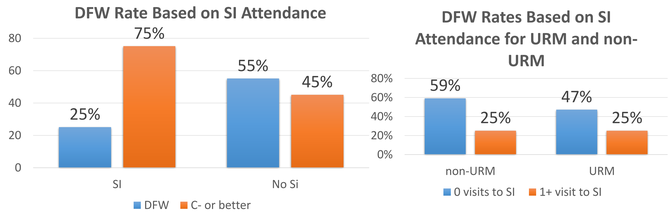
Fall '16: Course Redesign + SI

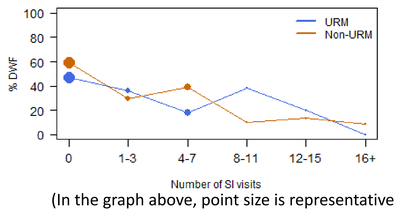
	DFW rate	URM DFW	nURM DFW	URM AG	FG DFW	nFG DFW	FG AG	Pell DFW	nPell DFW	Pell AG	M DFW	W DFW	Gender AG
Fall 2014	44%	56%	40%	16%	46%	43%	3%	49%	40%	9%	49%	38%	11%
Fall 2015	34%	47%	26%	21%	43%	27%	16%	43%	26%	17%	32%	37%	5%
Spring 2016	35%	43%	28%	15%	47%	23%	24%	42%	29%	13%	39%	33%	6%
Fall 2016	32%	31%	33%	2%	31%	34%	2%	31%	33%	2%	31%	34%	3%



Third semester of implemented Course Redesign with Technology (CRT) and *first semester of SI:*

- DFW dropped by 28% compared to Fall'14, consistent with other CRT semesters.
- Significant decrease in all achievement gaps compared to prior semesters.

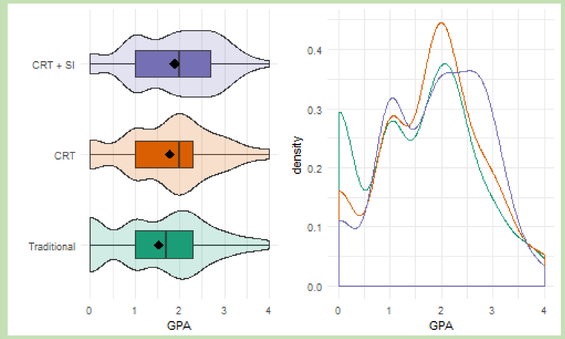




(In the graph above, point size is representative of the number of students in each bin.)

- DFW rates for students that attended SI one or more times were equalized;
- DFW rate decreased with increased SI attendance for both URM and non-URM students.

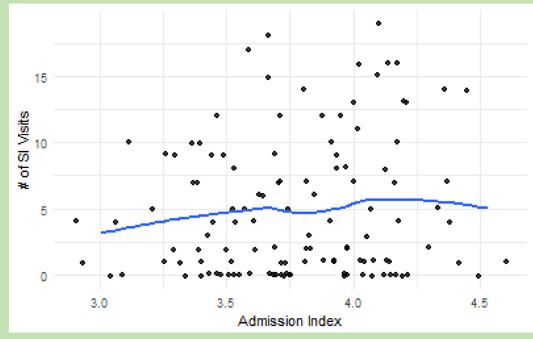
Effects of SI on Student Success



Overall difference in means.

An ANOVA test for equal means followed by a Tukey's HSD for each paired difference shows that the average GPA was:

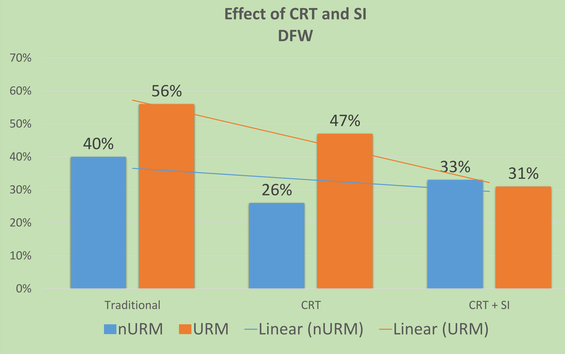
- 0.19 higher in CRT vs Traditional (p=.09)
- 0.36 higher in CRT + SI vs. Traditional (p=.01)

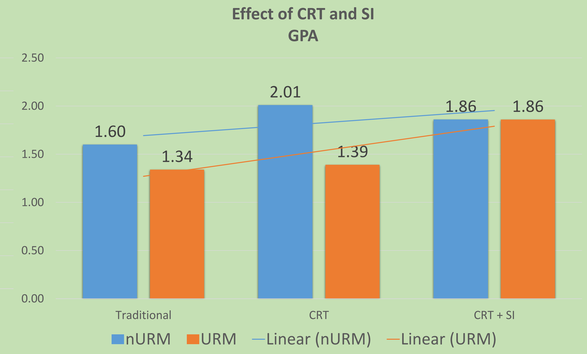


Linear regression of Admissions Index on # of SI Visits. (≤20 visits; Admissions index ≥2.5)

There is no reason to believe that students with higher admissions index are more likely to attend SI.

- The strength of the correlation between admissions index and # of SI visits is nonexistent, r = 0.016;
- There is no significant linear relationship between admission index and # of SI visits (p=0.76);
- These model results don't change when looking at the entire sample (all visits, all students).





- DFW rates for non-URM vs. URM students were reduced by 17% and 45% respectively with the incorporation of CRT+SI versus the traditional classroom setting.
- CRT+SI minimizes the DFW achievement gap between URM and non-URM students;
- CRT+SI minimizes the GPA achievement gap between URM and non-URM students.

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