Changing Science and Mathematics College Classrooms

An Instructional Innovations Faculty Learning Community

Marla M. Bell
Associate Dean of Student Success
College of Science and Mathematics
Kennesaw State University

Kennesaw State University
College of Science and Mathematics

KSU's Complete College Georgia Goals

Goal 1: Increase the college readiness of students enrolling at KSU through external partnerships with TCSG institutions and K-12 schools.

Goal 2: Enhance academic and non-academic support services for targeted subgroups of students.

Goal 3: Promote excellence and innovation in education to aid student progression to graduation.

College of Science and Mathematics Student Success Initiative

- 5 Areas of Emphasis
  - Foster Collaboration and Instructional Innovation among faculty
  - Data driven advising and placement of students
  - Create a CSM version of KSU 1101 (first-year seminar)
  - Create alternate pathways within high DFW courses
  - Scaffold research/discovery experiences throughout a student's program of study

CSM - Meeting the Complete College Georgia Goals	CSM Student Success Initiative Actions
a. Implement pedagogical changes known to increase student success in gateway courses b. Create a culture of interdisciplinarity in all of our courses	Foster collaboration and instructional innovation among CSM faculty
c. Restructure courses and laboratory experiences around student engagement with the material and discovery	Scaffold research/discovery experiences throughout a student's program of study
d. Create a common first-year experience for students majoring in CSM disciplines that focuses on developing quantitative reasoning skills	Creation of a CSM implementation of KSU 1101 and of CSM first-year learning communities
e. Develop a robust advising structure that helps students find a pathway for success that fits their individual needs.	Data driven advising and placement of students Create alternate pathways within the high DFW courses

CSM Gateway Courses

CHEM 1211 (General Chemistry I)
MATH 1111 (College Algebra)
MATH 1113 (Precalculus)
MATH 1190 (Calculus)
PHYS 2211 (General Physics I)

Undergraduate Research

1. CSM KSU1101 - Participation in a community research project that serves as an introduction to scientific research (generate a hypothesis around a common question, collect and interpret data, and present results)
2. CSM Disciplines - make use of Directed Methods courses and Directed Study (to expand on and deepen student understanding of discovery research for those students who have the opportunity to engage in undergraduate research outside of the formal course curriculum

First Year Experience

Learning objectives:

1. Study skills
2. Academic/Cognitive skills
3. Critical thinking skills

- Focus on developing and using quantitative skills as related to these learning objectives.
- Focus on developing STEM habits of mind.
- Focus on developing a community of peers, advisors and faculty.

Advising

1. Help individual students discover a curriculum pathway that gives them the best opportunity for success - evaluate the student's preparation and use that evaluation to proactively advise the student on their course selection.
2. Develop an "early alert" system by which advisors are informed when advisees experience difficulties within the first month in a course.
3. Create alternative pathways for students through the gateway courses that provide interventions based on the student's level of preparation – identify potential problem spots in the curriculum for individual students and provide intervention.

Faculty Learning Communities

Fostering collaboration and instructional innovation

Kennesaw State University
College of Science and Mathematics

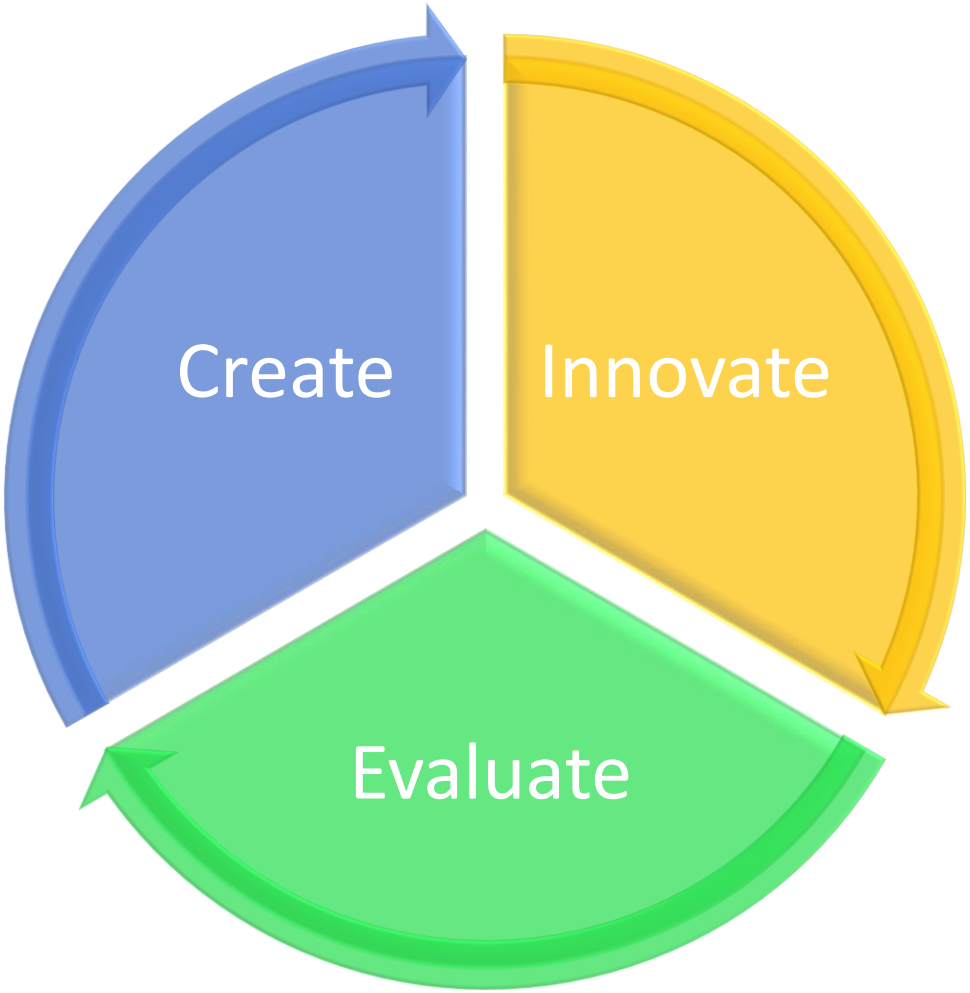
FLC Overview

- Collaborative effort between College of Science and Mathematics (CSM) and the Center for Excellence in Teaching and Learning (CETL)
- Addresses the Complete College Georgia Goals:
  a. implementing pedagogical changes known to increase student success in gateway courses, and
  b. creating a culture of interdisciplinarity in all of our courses by fostering collaboration and instructional innovation among CSM faculty

FLC Overview

- An opportunity for faculty to become involved in the design and implementation of instructional innovations that foster our students' learning
- First round involved 9 instructors, 4 mentors
- Instructors will teach at least one section of a gateway course during the Fall 2016 semester
- Mentors actively participate in all aspects of the FLC and support instructors in meeting the goals.

FLC Cycle



FLC Overview

- Three components:
  - ❖ Working Group – exploring ideas for instructional innovations (spring semester)
  - ❖ Course (re)Design Institute – creating and sharing course materials to support instructional innovation, designing research project to examine the impact of instructional innovations (summer)
  - ❖ Innovation and Reflection - implementing instructional innovation, annotating or revising instructional materials, collecting and analyzing data, sharing preliminary findings (fall-spring semesters)

Working Group Topics

- Reflecting on teaching and learning
- Helping students organize knowledge to support their learning
- Motivating students to learn and persist
- Supporting students early in the semester
- Helping students to develop successful study habits and learn from assessments
- Flipping your course, creating instructional videos and off-line content, using clickers
- Developing innovative practices over time
- How to assess if instructional innovations are working

Working Group Beyond the Topics

- "Safe space" for faculty to express fears, hesitation, skepticism, self-interest, …
- Space and time for faculty to learn about a variety of instructional innovations and decide what they wish to try in their own classes.
- Collaborative teams formed naturally.

Summer Institute Topics

- Creating an environment to support student learning
- Classroom assessment techniques/holding students accountable
- Teaching and reaching first-year, transfer students, and marginalized students
- Technology for teaching and learning/flipping the classroom
- Pursuing scholarly teaching and the scholarship of teaching and learning
- Quantitative and qualitative research design and analysis techniques
- Grading and course alignment
- Leveraging peer leaders
- Developing IRB applications

Summer Institute Beyond the Topics

- The discussions were facilitated by a variety of experts from across campus.
- FLC members were given time to develop one complete unit (lessons and assessments) implementing their planned innovation.
- FLC members each developed a plan to assess the effectiveness of the implementation.

Innovation and Research Plan

- At the end of the summer institute, each participant turned in a two page document, detailing
  - Planned innovation, including what they were trying to impact with this change
  - Details of their research project: question to be answered, data, analysis plan
  - Plans to share findings with others

Fall FLC Meeting Plans

- FLC Meetings (5 planned)
- Additional Session Equivalents (3):
  - Leading a KSU1101 session
  - Structured peer instructional innovation or research working session
  - Instructional innovation/research-based practice presentation to colleagues (e.g., math talks, brown bag lunch, reading group)
  - Peer or CETL classroom observation and debriefing discussion
- Artifacts
  - Annotated observation notes or observation reflection
  - Working session executive summary (approximately 1 page)
  - Presentation slides or materials

Example of an FLC Plan for a Calculus I Class

- Early intervention to strengthen prerequisite knowledge will be implemented. This will include lessons focused on algebra and trigonometry most needed in Calculus, an early test on said material, and a chance for revision and retest for weak students.
- My lecture "system" will be modified to include frequent clicker polling (immediate formative assessment).

Another Example of an FLC Plan for a Calculus I Class

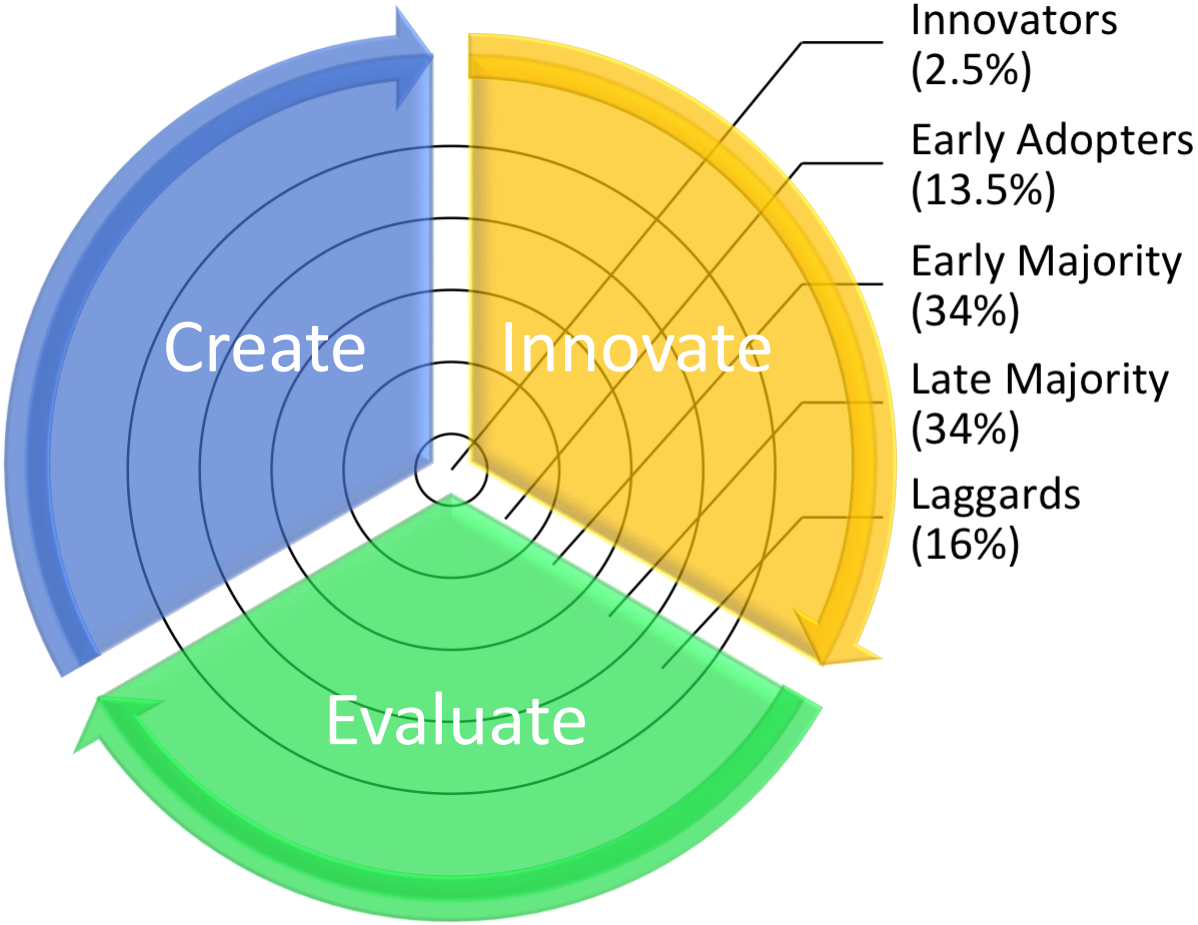
- I am flipping my class.
- Students will turn in both a pre-class and an in-class worksheet for nearly every lecture. Additionally, I want to hold a mid-semester course evaluation or SGID (small group instructional diagnosis) to capture students' opinions on the flipped environment.

What I'm excited about

- Our colleagues learned so much about what the research says and about a variety of options available for them to try.
- We all learned that there are experts all around us, people who are using innovative strategies or colleagues who are experts in things like student behavior or classroom culture.

What I'm Excited About

- My colleagues were each able to innovate within their own comfort zone. We aren't pushing a "one-size-fits-all" solution.
- Each person was compelled to think about this work in a scholarly manner. "What are you trying to affect?" "How will you know/show it has worked?"
- Each person has a network of colleagues with which to collaborate and share, a network that should grow over time.



Rogers, E. M., (2003). Diffusion of Innovations, Fifth Edition. New York: Free Press.

What I'm Most Excited About

- In Fall 2016, 340 Math students and 575 Chemistry students will be taught in classrooms where research-based teaching innovations will be employed.
- Results will be assessed and the improvement cycle will continue.

Questions?