

*DTS Workshop Series: Strategies
That Increase the Retention and
Academic Performance of
Underrepresented Students on
Campus: A Step-by-Step Approach
Towards Achieving Success*

Gretchen Adams
Distinguished Teacher-Scholar
November 21, 2014

November Focus

- Instructional strategies that improve retention and academic performance among underrepresented groups

***Instructional Strategies:
Inside the Classroom and Out***

- Chemistry 101 (Introductory Chemistry)
- Chemistry Merit Program for Emerging Scholars
- Undergraduate research and faculty/graduate student mentoring

***Understand Your Audience:
Chemistry 101 vs. 102***

- Average Math ACT
 - Chemistry 101 students = 26
 - Chemistry 102 students = 31
- Average Chemistry Placement
 - Chemistry 101 students = 9
 - Chemistry 102 students = 19

Understand Your Audience: Chemistry 101 (Fall 2013)

Major	Percent of Students
Undeclared	208/659 = 31.6%
ACES	181/659 = 27.5%
Biology	77/659 = 11.7%
Applied Health Sciences (Community Health/Kinesiology/SHS)	98/659 = 14.9%
Engineering	32/659 = 4.9%
Chem/Biochem/Chemical Engineering	12/659 = 1.8%
Psychology	26/659 = 3.9%
Other	25/659 = 3.8%

Understand Your Audience: Chemistry 101

- Largest percentage of underrepresented students in our department's courses (40% minorities; 66% female)
 - High risk for dropping out of STEM majors
- ACT scores of my minority students are lower than their counterparts (~24 Math ACT)
- 34% of my students are first-generation students
- 91% of my students are incoming freshman

Instructional Strategies

- Course format strategies
- Online strategies
- Mentoring strategies

Course Format Strategies

- Lecture
 - i-Clickers
 - Real-world and personalized examples and analogies

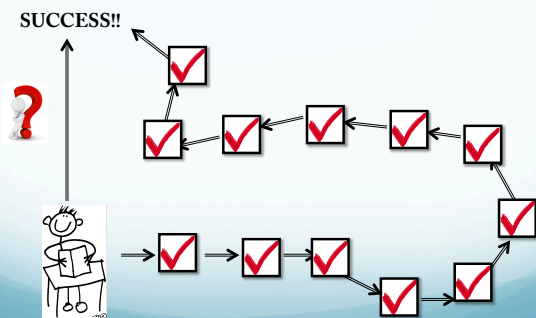
Course Format Strategies

- Lab
 - All experiments and activities are collaboration-based.
 - Lots of writing! Explanations, drawings, show all work!

Course Format Strategies

- Discussion
 - Discussions are collaboration based.
 - Students work together on problems in groups.
 - TA facilitates.

Frequent Assessments!



Online Strategies

- Algorithm-based homework is online
- Pre-lecture assignments
- Monday Morning Message
- Video hints and tutorials
- StudyCloud

Mentoring Strategies

- Studies show that undergraduate students who are mentored tend to have higher GPAs, higher retention rates, and more units completed per semester as compared to their un-mentored colleagues.

T.A. Campbell and D.E. Campbell, "Faculty/student mentor program: Effects on academic performance and retention," *Research in Higher Education*, vol. 38, pp. 727-742, 1997.

Mentoring Strategies

- One-on-one mentoring as much as possible!

Mentoring Strategies

- Train TAs to be mentors

Mentoring Strategies

- Incorporate opportunities for peer mentoring.
 - Lab and discussion
 - Online homework

R. Baez-Galib, H. Colon-Cruz, W. Resto, and M.R. Rubin, "Chem-2-chem: A one-to-one supportive learning environment for chemistry," *Journal of Chemical Education*, vol. 82, pp. 1859-1863, 2005.

E.G. Cohen, *Designing Groupwork: Strategies for the Heterogeneous Classroom*. Columbia University, New York: Teachers College Press, 1994.

L.A. Denofrio, B. Russell, D. Lopatto, and Y. Lu, "Mentoring: Linking student interests to science curricula," *Science*, vol. 318, pp. 1872-1873, 2007.

D.K. Gosser and V. Roth, "The workshop chemistry project: Peer-led team learning," *Journal of Chemical Education*, vol. 75, pp. 185-187, 1998.

Mentoring Strategies

- Utilize email frequently
 - Exams
 - Email individual students and advisors for students at risk

Worth the Effort

- Analysis shows:
 - Students that place into and participate in Introductory Chemistry before enrolling in our mainstream General Chemistry I course earn **at least one full letter grade higher** versus those that place into Introductory Chemistry and do not participate.

Merit Program for Emerging Scholars: Background

- Dr. Uri Treisman's collaborative learning model
- Students work in groups
 - Challenging worksheet or activity
 - TA facilitates
 - Few Immediate Direct Answers
- Goal – improve retention through:
 - Improving academic performance
 - Increasing confidence and self-identity
 - Establishing academic peer groups
 - Mentoring

How Merit "Fits In"

- Merit students attend same labs and lectures and take the same exams
- Merit workshops replace regular recitation sections (in most cases)
- Extra 2-3 hours a week = Chem 199 credit
- Additional advising from Merit Director and TAs

Instructional Benefits of the Merit Model

- Students model how to think about problems
- Students are required to be active participants in their own education
- TA can interact with the students and question them further
- Students become more confident around TA (and many times the professor for course)
- TA gets to know students more quickly

Recruiting Students

- Undeclared students (DGS)
- Any major that requires at least one year of general chemistry, calculus, or biology.
- Target underrepresented groups
 - Minorities
 - Students from Small Rural High Schools

Recruiting Students

- Initial selection based on:
 - Competitive ACT/SAT scores
 - 24 Math ACT (1060 SAT)
 - Avg. STEM major = 30 ACT (1310 SAT)
 - Meet during summer registration
- Also:
 - Advisor referrals
 - Word of mouth

Some Evaluation Data Results

- Retention in the chemical sciences
- Academic performance
- STEM degree completion
- Qualitative feedback

Retention

	Merit			Non-Merit		
	Initial Students	BS in Chem or ChemE	Retention Rate	Initial Students	BS in Chem or ChemE	Retention Rate
Overall	442	229	52%	1626	641	39%
Asian	61	32	52%	340	151	44%
White	250	141	56%	1151	450	39%
African American	77	34	44%	41	7	17%
Hispanic American	42	14	33%	44	8	18%
Male	210	118	56%	992	411	41%
Female	232	111	48%	634	230	36%
Small HS	84	38	45%	176	50	28%

G.M. Adams and J.M. Lisy, "The chemistry merit program: Reaching, teaching, and retaining students in the chemical sciences," *Journal of Chemical Education*, vol. 84, pp. 721-726, 2007.

Academic Performance: Chemistry 102 (Fall 2013)

Letter Grade	All Students (1374)		Merit URM (46)		Non-Merit URM (194)	
	Count	Percentage	Count	Percentage	Count	Percentage
A	224	16.30%	1	2.17%	6	3.09%
B	460	33.48%	17	36.96%	50	25.77%
C	452	32.90%	19	41.30%	69	35.57%
D	167	12.15%	7	15.22%	43	22.16%
F	64	4.66%	2	4.35%	25	12.89%
NC	1	0.07%	0	0.00%	1	0.52%
ABS	5	0.36%	0	0.00%	0	0.00%
I	1	0.07%	0	0.00%	0	0.00%
Course GPA	2.44		2.20		1.82	
Math ACT	31.42		27.76		28.23	
Comp. ACT	29.90		27.41		27.38	

Academic Performance: Chemistry 232 (Fall 2013)

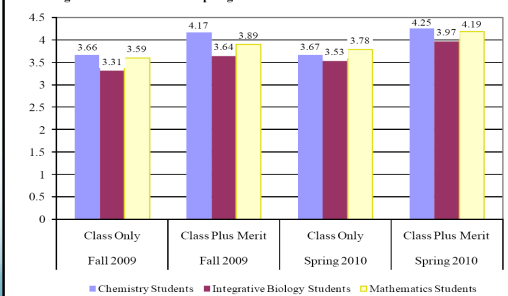
Letter Grade	All Students (736)		Merit URM (22)		Non-Merit URM (77)	
	Count	Percentage	Count	Percentage	Count	Percentage
A	163	22.15%	4	18.18%	5	6.49%
B	274	37.23%	10	45.45%	31	40.26%
C	206	27.99%	5	22.73%	24	31.17%
D	70	9.51%	3	13.64%	14	18.18%
F	19	2.58%	0	0.00%	3	3.90%
NC	0	0.00%	0	0.00%	0	0.00%
CR	1	0.14%	0	0.00%	0	0.00%
ABS	2	0.27%	0	0.00%	0	0.00%
I	1	0.14%	0	0.00%	0	0.00%
Course GPA	2.67		2.68		2.25	
Math ACT	30.24		27.32		27.41	
Comp. ACT	29.30		26.36		27.00	

STEM Degree Completion (Undeclared Majors)

- To date, **48%** of our Merit undeclared students have graduated with a STEM degree as opposed to only **33.5%** of our Non-Merit comparison group, indicating that the Merit Program is effective at both retaining and recruiting students into STEM fields.

Students' Personal Learning

Figure 1. Student Personal Learning Ratings for the "Class Only" Vs. the "Class with the Merit Program" in Fall 2009 and Spring 2010



Student Feedback

- "I like working in groups as others' ideas help me to learn and see other approaches to different problems, as well as not having the answers just given to me."
- "It has really helped by providing a more challenging atmosphere in learning so the tests do not seem as hard."
- "The small groups allow discussion on problems where everybody can participate; this participation is integral to learning and allows our brains to actually process the information in a way that it sticks."

Undergraduate Research

- Participation in undergraduate research improves retention in the STEM fields.

E. Anderson and D. Kim, *Increasing the Success of Minority Students in Science and Technology*. Washington, DC: American Council on Education, 2006.

M.T. Jones, A.E.L. Barlow, and M. Villarejo, "Importance of undergraduate research for minority persistence and achievement in biology," *The Journal of Higher Education*, vol. 81, pp. 82-115, 2010.

Undergraduate Research

- Based on student feedback from a department-wide chemistry climate survey, revamped the undergraduate research process to make it easier for students to find faculty research groups.
- Secured funding

Undergraduate Research

- Interviewed students (all underrepresented) indicated that the experience and faculty mentoring has led to **increased confidence, applicability of coursework, and enjoyment of the major.**

Key Points

- Try to understand your audience.
- What works? Can this be adapted to your department, program, classroom, personal style?
- Evaluate
- What else? What is your “take home” message?

Assignment



- What are some strategies you would like to implement in your courses, programs, or department? Develop a game plan for implementation.