

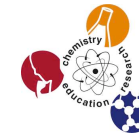


Chemistry Education Research Doctoral Fellows Program

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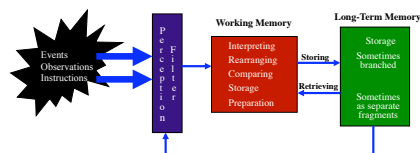
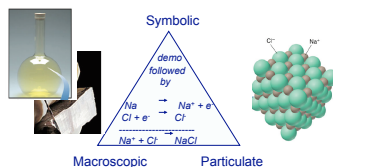


Project Goals

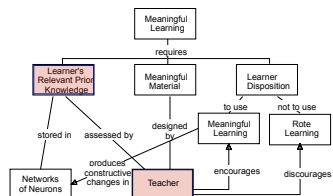
- Recruit, train, and graduate a diverse group of scholars in chemistry education research (CER) who specialize in assessment.
- Design coursework, K-12 partnerships, research experiences, and mentoring to successfully prepare these scholars for careers in CER.
- Create a community of scholars to collaborate and systematically improve assessment of student learning.

Theoretical Frameworks

- Johnstone's Domains (Johnstone, 1991, *J. Cmptr. Asst. Ling.*, 7, 78-81)
 - Information processing model (Johnstone, 2007, *J. Chem. Educ.*, 74, 262-268)
 - Macroscopic/particulate/symbolic simultaneously inflicted upon learner



- Novak's Human Constructivism (Bretz, 2001, *J. Chem. Educ.*, 78(8), 1107)
 - Prior knowledge includes concepts and knowledge about how to learn
 - STEM Education researchers must have deep content knowledge



CER Fellowship Funding

- \$30,000 stipend, tuition, fees, health insurance (5 years)
- Laptop computer & travel to 2 conferences per year

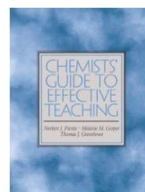
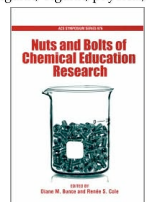
Chemistry Education Research



- 27 Ph.D. programs in CER housed in Departments of Chemistry
 - "Many of the papers in chemistry education still follow the old paradigm: evaluation of one teaching method versus another with little or no reference to the underlying learning theory or presentation of isolated bits of information on the teaching/learning process."
 - "Chemistry education researchers have been hampered by their relative isolation since few universities have more than one chemistry educator."
- ~Committee on Benchmarking the Research Competitiveness of the United States in Chemistry. *The Future of U.S. Chemistry Research: Benchmarks and Challenges*; National Academies Press: Washington, 2007

Program Requirements

- Chemistry & CER Coursework
 - Cognate area 3 courses (analytical, biochemistry, inorganic, organic, physical)
 - Proficiency in 2 additional disciplines
 - Chemical Misconceptions & Conceptual Change
 - Learning Theories in Chemistry Education
 - Assessment & Pedagogical Content Knowledge
 - Statistic & Qualitative methodologies
- Cognate Discipline Research
 - Undergraduate laboratory experiment
 - Traditional synthesis / characterization research
- Qualifying Written Exams & Original Research Proposal
- Dissertation Research: Concept Inventory Development



Concept Inventories

- Extensive literature reporting chemistry (& precursors) misconceptions K-16
- Few instruments available to quantify student misconceptions in chemistry
- Constructivist Interview of Representational Competence (Linenberger & Bretz, submitted)

Interview Phase	Interactions with Student
1	Free response probes to elicit prior knowledge
2a & 2b	Explore reasoning between prior knowledge and representation #1 Induce cognitive dissonance with representation #2
3	Representational competence and application of knowledge
4	Reflection upon interview process



Michael Bindis
Intermolecular Forces & Chromatography



Jana Jensen
Acid Base Reactions



Cynthia Luxford
Lewis Dot Structures beyond Octet Rule



Ana Vasquez Murata
Atomic Emission & Energy Level Diagrams



Ashley Warren
Protein Synthesis & Analogies

CER Graduate Student Summer Mentoring Conferences

- NSF-CCLI & REESE proposal panels
- Chemical Education manuscript reviews
- ACS Examinations Institute assessment
- Metacognition & Problem Solving
- Inquiry & SCALE-UP
- Poster Session abstracts available at <http://www.users.muohio.edu/bretz/>
- Next conference June 2011



2009 Conference Evaluation

Survey Responses

- 40 CER graduate students, 20 universities, 24 research groups
- worried that my research might not be 'good enough.' (53% pre/18% post)
- will benefit from the mentoring I received at this conference. (92%)
- met peers with whom I might collaborate after I graduate. (97%)
- "helped build a better networked CER community"
- "great opportunity to network with peers, doesn't happen at national meetings"
- "now we feel like a program instead of isolated groups at isolated schools"

Career Goals

- Conduct CER
- w/ undergrads (82%)
- w/ grad students (55%)
- High school teacher (13%)
- Community College (53%)
- Liberal arts (74%)
- R1 University (47%)

Project Evaluation

- Development & mentoring of CER scholars
- Quality of chemistry concept inventories
- Diversity & equity in K-12 partnerships
- Researcher Identity Construction processes

Table 1: Item Statistics for Pre/Post Affective Commitment Scales

#	Item	Occupational		Corrected Item-Totals		M		SD		
		pre (N=38)	post (N=36)	pre	post	pre	post			
1	I am proud to be a chemistry education researcher.	6.29	0.80	0.70	6.36	0.80	0.79			
3	I regret having become a chemistry education researcher.	4.18	1.04	0.49	4.47	0.77	0.85			
5	I dislike being a chemistry education researcher. I do not identify with the professional identity of chemistry education researcher.	4.32	0.77	0.88	4.47	0.77	0.83			
7	I am enthusiastic about doing chemistry education research.	4.08	0.97	0.53	4.42	0.81	0.85			
9	Doing chemistry education research is important to my self-image.	6.18	0.83	0.58	6.44	0.94	0.79			
11	Chemistry education research is important to my self-image.	4.37	1.48	0.28	4.78	1.29	0.46			
Organizational										
		pre (N=39)		post (N=39)						
2	I feel "emotionally attached" to the CER community.	5.05	1.38	0.74	5.82	0.97	0.72			
4	I really feel as if the CER community's problems are my own.	5.00	1.03	0.45	5.62	1.09	0.66			
6	I feel like "part of the family" in the CER community.	3.95	1.59	0.59	5.85	1.07	0.80			
8	I would be very happy to spend the rest of my career in the CER community.	5.82	1.05	0.64	6.28	0.86	0.76			
10	I have a strong sense of "belonging" to the CER community.	4.69	1.30	0.69	5.77	1.06	0.73			
12	The CER community has a great deal of personal meaning for me.	4.92	1.42	0.83	5.69	1.03	0.70			



Table 2: Means and Standard Deviations of Pre/Post Scale Scores

	Occupational**		Organizational**	
	M	SD	M	SD
pre	29.4	4.1	29.4	6.0
post	30.9	0.72	35.0	0.70

**N=38 pre, N=36 post

**N=39



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