Some Lessons Learned:

Researching and Evaluating STEM Teaching & Learning in K-12 and Higher Education

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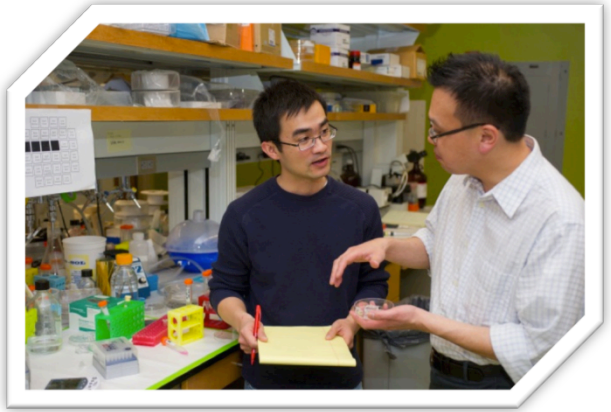
Georgia Tech Initiatives on Teaching & Learning

"You might ask why Georgia Tech would be interested in K-12 education – the reality is that without well prepared students, we at Tech cannot continue to provide the best engineers, technologists and scientists in the world. For this reason Georgia Tech has taken a leading role in expanding K-12 STEM education."

-DR. G.P. "BUD" PETERSON, President of the Georgia Institute of Technology

- **Higher Education—Center for the Enhancement of Teaching and Learning (CETL)**



- **K-12—Center for Education Integrating Science, Mathematics and Computing (CEISMC)**

SLIDER

NSF DRK-12 Program (10/2009—9/2014)

Curricular Reform Project

Program Goals—*To develop, and implement in "real" schools, an 8th grade project-based inquiry learning curriculum for physical science that:*

- Contextualizes science within engineering scenarios
- Emphasizes science process and engineering design
- Uses LEGO Mindstorm robots as a manipulative and hook

SLIDER Research Questions:

- Can this type of curriculum:
  - Empower a broad range of middle school learners to learn physical science content and reasoning skills?
  - Increase student engagement, motivation, creativity and interest in STEM fields?

- Do students engage with the materials differently depending upon their gender, race, socioeconomic status, or prior academic achievement level?

- How should the learning that takes place best be assessed in the classroom?

- What type of support, both in instructional materials and professional development, is necessary to adequately prepare teachers to deliver this type of curriculum?

Tech to Teaching

NSF Innovation through Institutional Integration

1/2009-12/2013

Program goals

- To create an infrastructure on the Georgia Tech campus that encourages and enables students to effectively pursue careers in K-12 or college teaching; and
- To develop and implement programming that ensures these students succeed in their initial years in these career paths

Tech to Teaching Evaluation Questions:

- Have we set up the appropriate infrastructure (classes, advising, mentoring, immersion experiences, induction)?
- Are students participating? (If you build, will they come?)
- Have we changed the fundamental culture on campus (as measured by pre/post surveys and interviews)?

GoSTEM

GoSTEM

Funded by the Goizueta Foundation

6/2011-5/2012, pending for 6/2012-5/2017

Vertically integrated programs to encourage Hispanic student achievement

- Tutoring and mentoring by GT students
- Curricular programs (e.g. robotics)
- Parental programs
- Involvement by GT faculty, student organizations

GoSTEM Evaluation Questions:

- Level of involvement of GT faculty and students
- Indications that GT views Hispanic achievement as part of its responsibility
- Changes in K-12 student achievement
- Curricular changes

An Excerpt…

"In the varied topography of professional practice [in education], there is a high hard ground overlooking a swamp. On the high ground, manageable problems lend themselves to solution through the use of research-based theory and technique. In the swampy lowlands, problems are messy and confusing and incapable of technical solution. The irony of this situation is that the problems of the high ground tend to be relatively unimportant to individuals or to the society at large, however great their technical interest may be, while in the swamp lie the greatest problems of human concern. The practitioner [researcher] is confronted with a choice. Shall he remain on the high ground where he can solve relatively unimportant problems according to his standards of rigor, or shall he descend to the swamp of important problems where he cannot be rigorous in any way he knows how to describe?"

Schön, D. A. (1995). "The new scholarship requires a new epistemology." *Change*, 27(6), 27-34.

Model Description

Entities (Systems of Actors):

- Students
- Teachers
- School Leadership
- School System Administration
- Community
- Government

Attributes (States of the Actors):

- Affective (emotions, morale)
- Cognitive (intelligence, ability to learn)
- Conative (impulse, desire, volition, striving, grit)
- Intra-group relationships
- Inter-group relationships

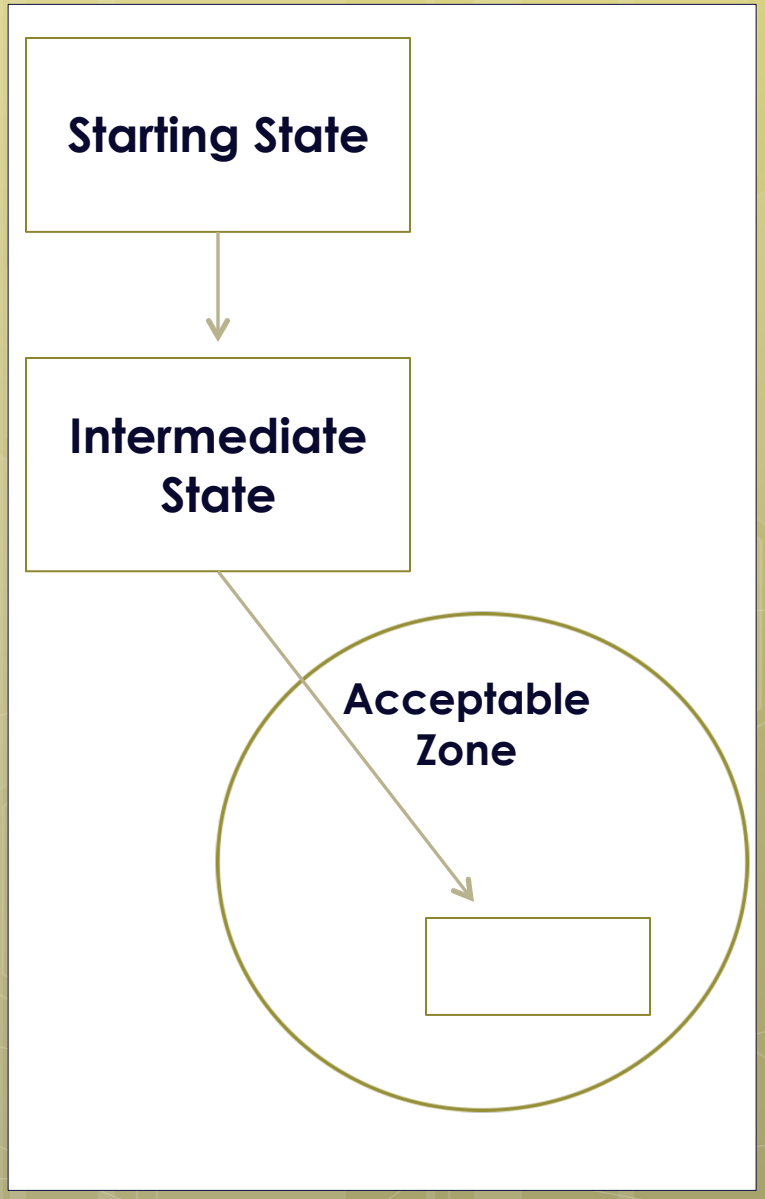
Result

- Each State in the System is described by 30 variables

Matrix Form of the Model

Actors (Systems)	Affective (emotions)	Cognitive (intelligence)	Conative (impulse, desire, volition, striving)	Intra-relationships	Inter-relationships
Student Population	Morale, motivation, self expectations		Willingness to work, take initiative, perseverance, Grit		
Teachers (as a group)		Content knowledge, ability to learn		Teamwork, collaboration, planning, trust, communication	
School Leadership			Solve problems, confrontations, action		Managing up/ down to school system, to teachers/students, to community
School System Administration				Micro- vs. macro management, willingness to confront	Managing in/out to schools, community, government
Community	Expectations of academic achievement		Activism regarding education, impact on school (local media, parent groups, etc.)		
Government (State DoE, Fed, County)		Standards, testing		Alignment of policies, rules, laws, etc.	

Model Transitions



State transitions take place over time

and…

Movement from one state to another requires money and other resources.

Acceptable Zone = where the intervention/reform can be successful

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