Panel: Tales from the Field – Cross-College Curriculum Development

RIGOROUS RESEARCH in ENGINEERING EDUCATION

Funded by the **National Science Foundation** through awards DUE 0341127 and DUE 0817461

ASEE/IEEE Frontiers in Education Conference
Session F4B,
October 14, 2011
Rapid City, SD

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Overview

- Introductions and panel overview – Ruth Streveler
- Overview of Alverno project – Tim Riordan
- Participants
  - Eric Johnson, Valparaiso University
  - Stuart Kellogg, SDSMT
  - Odesma Dalrymple, Arizona State University
- Q&A

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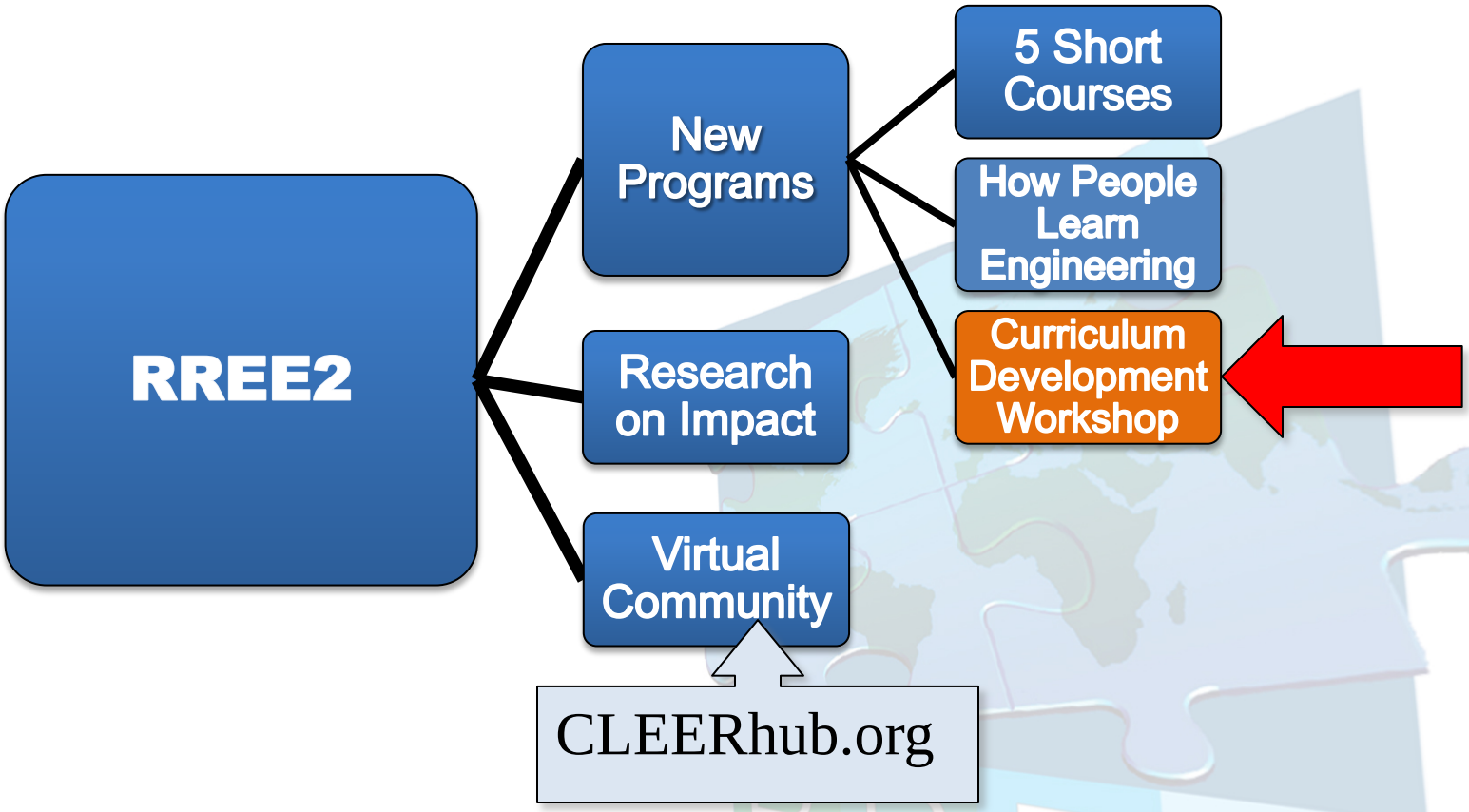
Expanding and sustaining research capacity in engineering and technology education: Building on successful programs for faculty and graduate students

Collaborative partners: Purdue (lead), Alverno College, Colorado School of Mines, Howard University, Madison Area Technical College, National Academy of Engineering



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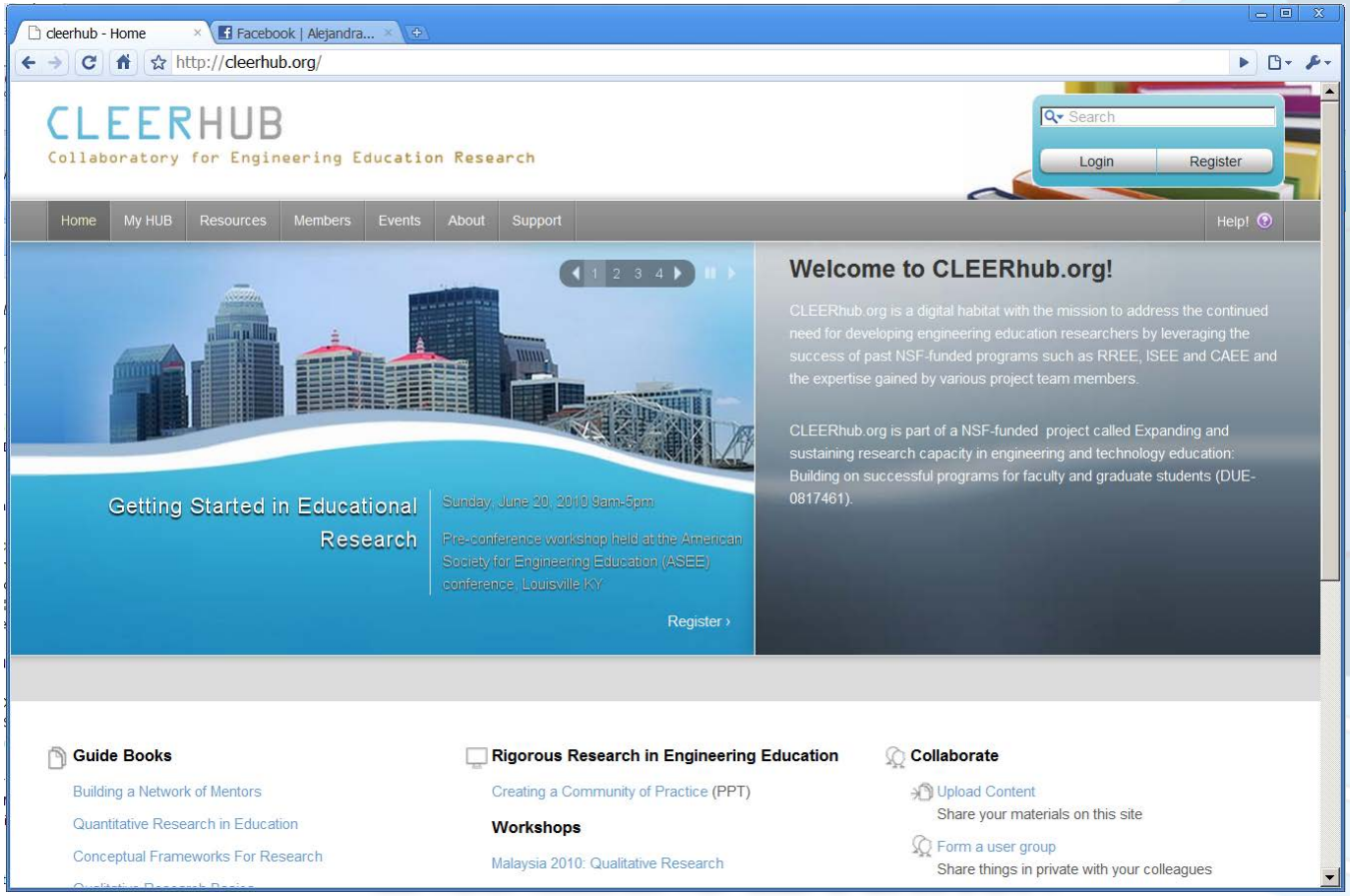
CLEERHUB

Collaboratory for Engineering Education Research



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Engineering Curriculum Design Project

Tim Riordan

Alverno College

Dimensions of Project

- Articulating learning outcomes for students
- Designing curriculum based on learning outcomes
- Designing courses to engage students actively and developmentally
- Creating forms of collaborative inquiry that foster curriculum development and scholarly teaching
- Identifying and reflecting on conceptual shifts

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Project Activities

- Schools selected for participation (3 cohorts)
- Teams from schools identify curriculum projects
- Teams participate in June workshop at Alverno
- Teams return to Alverno for follow-up meeting to report on progress

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Participating Institutions

- Arizona State University
- Hampton University
- South Dakota School of Mines and Technology,
- United States Military Academy
- Valparaiso University
- Waukesha County Technical College
- Worcester Polytechnic Institute

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What should students be able to do and how should they be able to think as a result of study in your . . .

- **Institution**
- **Program**
- **Course**

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Alverno Abilities

- Communication
- Analysis
- Problem Solving
- Valuing in Decision-Making
- Social Interaction
- Developing a Global Perspective
- Effective Citizenship
- Aesthetic Engagement

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Analysis

① Observes accurately
② Draws reasonable inferences from observations
③ Perceives and makes relationships
④ Analyzes structure and organization
⑤ Refines use of disciplinary frameworks
⑥ Independently applies disciplinary frameworks

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Connecting Student Learning Outcomes to Teaching, Assessment, Curriculum
June 11-13, 2012

- Tim.Riordan@Alverno.edu

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Participants' Experience

Creating a Comprehensive Design Experience throughout all Degree Programs in the College of Engineering at Valparaiso University

Eric W Johnson
Professor and Chair of Electrical and Computer Engineering

Valparaiso University

Valparaiso University's College of Engineering

- Located within a small comprehensive university (total undergraduate enrollment approximately 3000)
- College of Engineering Enrollment: 325
- Entirely Undergraduate
- Three Departments (Civil, Electrical and Computer, Mechanical) and 18 full-time faculty
- Four ABET accredited programs: Civil, Computer, Electrical and Mechanical

Current Status of Design in COE

- Design taught in a number of courses throughout each program.
  - No consistency in how design is taught from course to course or program to program.
  - Design experience is not coordinated from year-to-year.
  - Most design involves small projects that are not open-ended until the capstone course.
- Challenges in the year-long multi-disciplinary senior capstone course:
  - Lack of understanding of the entire design process
  - Lack of creativity when dealing with open-ended problems

Overall Project Goals:

- Investigate how design is being taught throughout the curriculum
- Develop learning outcomes related to design for each class (first-year, sophomore, junior, senior).
- Develop an implementation and assessment plan for a new design curriculum across all programs.
  - Identify courses where design can be assessed throughout each program (individual and team)
  - Promote significant student participation in annual Design Expo

Link to Alverno Model and Engineer 2020

- Alverno Model
  - View *design* as a core ability
  - Use ongoing assessment and feedback throughout programs
- Engineer 2020
  - Improved design competency has a direct link to first three attributes: *Analytical Skills, Practical Ingenuity* and *Creativity*
  - An comprehensive design experience can also link to the fourth attribute involving *Communication and Teamwork Skills.*

Important Successes

- Strong administrative support for the effort.
  - Realization of the problem from all three departments and buy-in from the chairs of each department.
- Developed a project plan including preliminary schedule.
- Begun the review of department strategies to teach and evaluate design.
  - current methods/strategies to teach design
  - current methods/strategies to evaluate student design abilities
  - performance criteria required to be a successful design engineer

Challenges Faced

- Challenge: Effort led by Chairs.
  - Lack of significant time to work on the project during the academic year due to other responsibilities.
  - One chair on sabbatical this fall; another next spring
- Solution: One Chair leads effort, other two in supporting role.
- Challenge: Faculty attitudes
  - “My way to teach design is the best way”
  - Assessing design only through a grade
  - Design focus is more on the solution
- Solution: Link teaching design and evaluating student design abilities to conceptual frameworks and existing best practices in literature in effort to change attitudes.

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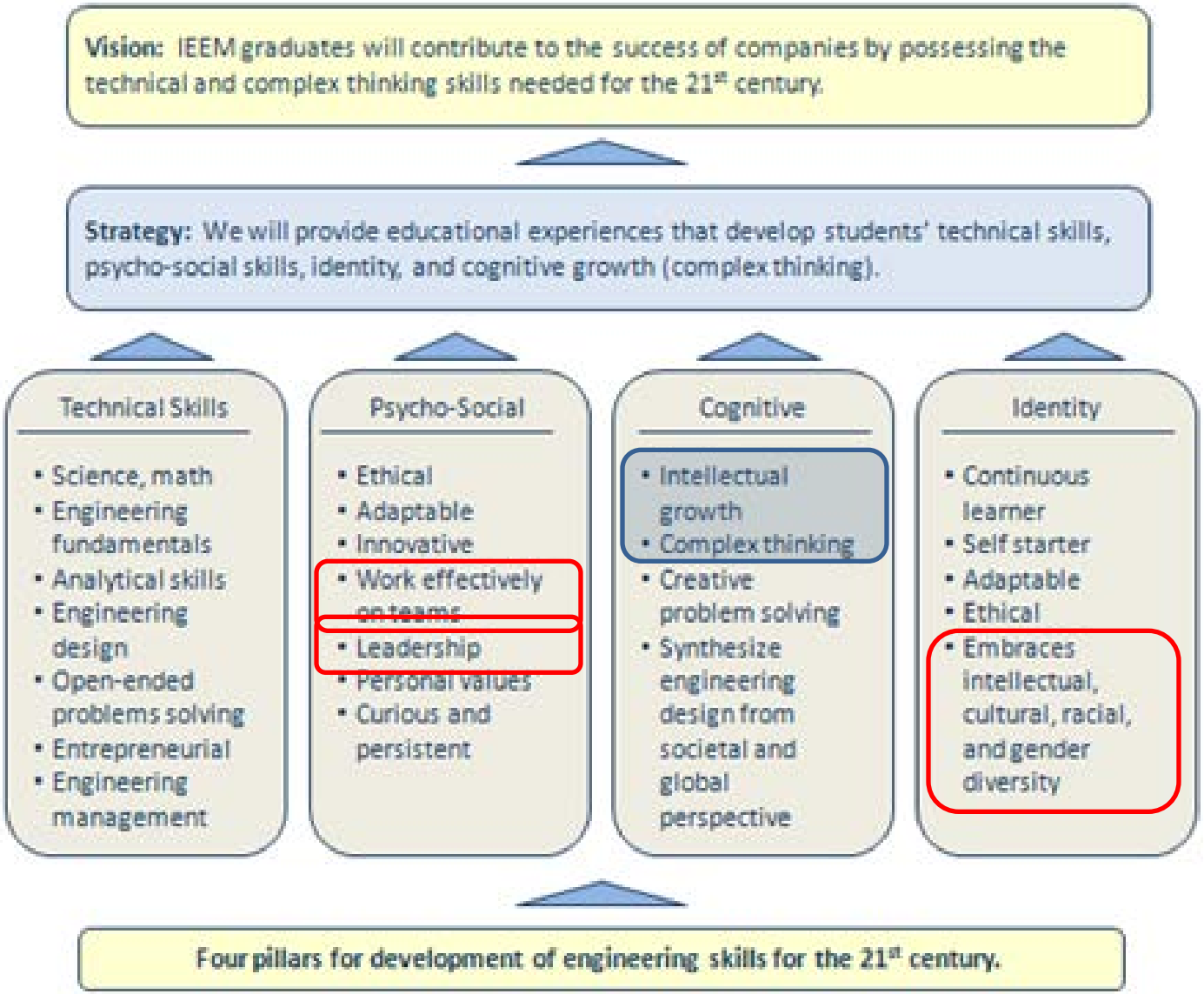
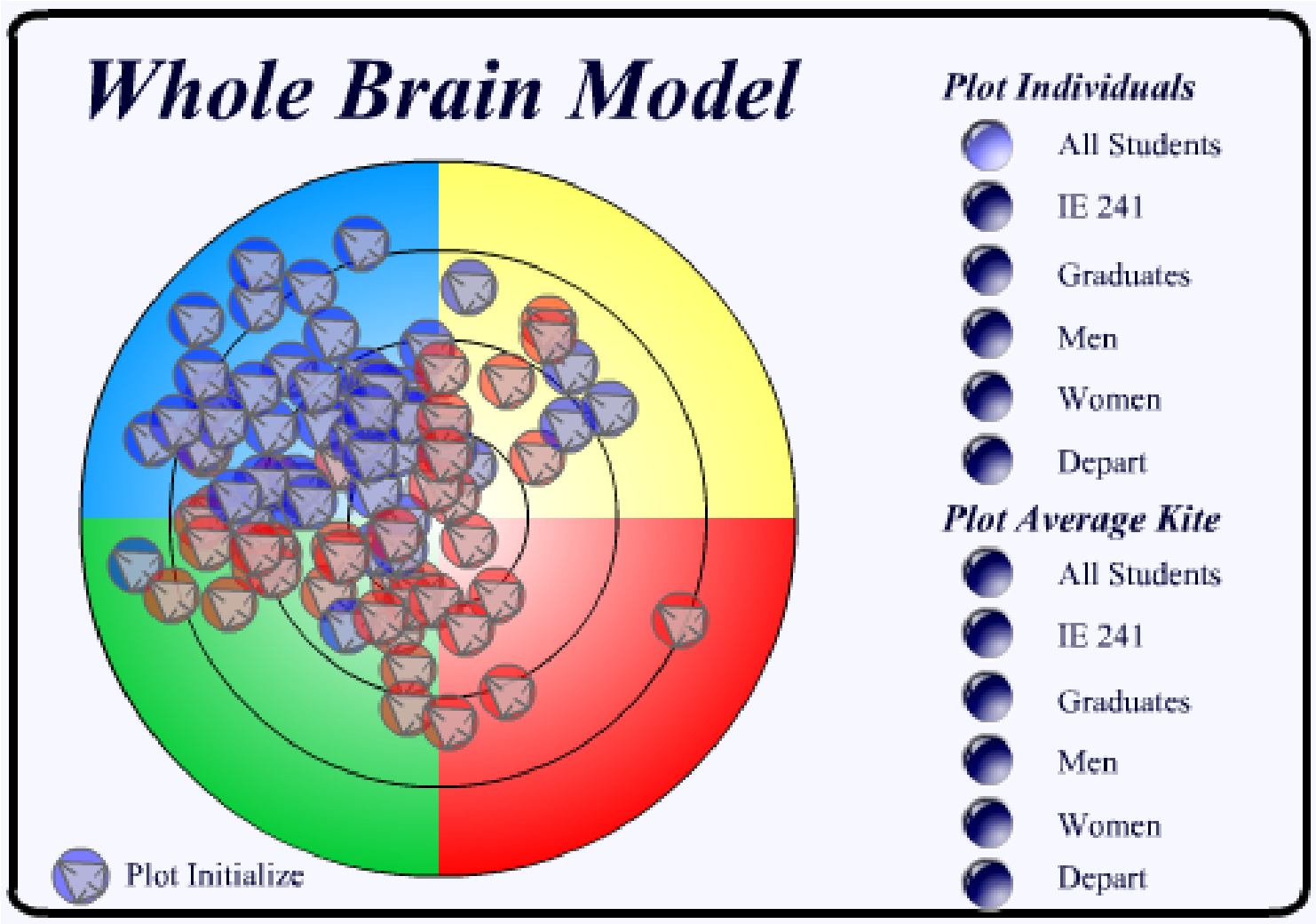
Stuart Kellogg

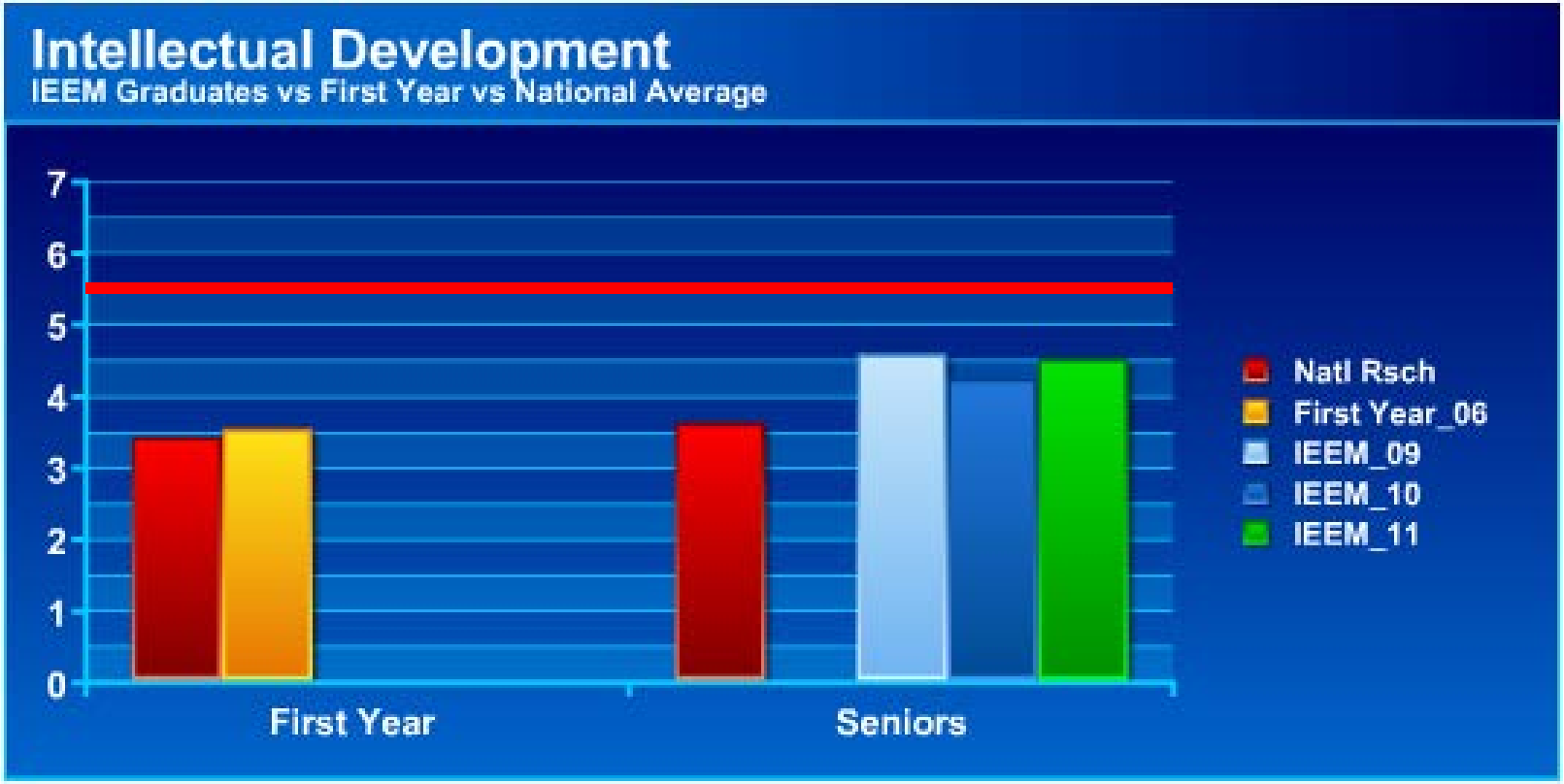
21st Skills Require a Transformation



Multi-perspective Problems
Require Multi-perspective Views



IEEM Graduates are consistently ½ to 1 step higher on the intellectual scale than their national peer group.



Project: Better Complex Thinking
Will come from Better Team Skills

Project:

Improve multi-disciplinary communication and team problem solving skills.

Revelations:

- **Curriculum development and Assessment can be one and the same**
- **If you want students to perform, you must explicitly state the criteria by which they will be evaluated**

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Status:

- **Explicit criteria for multi-disciplinary communication is in place**
- **Explicit criteria for multi-disciplinary teams / behaviors under review (hint: look at CATME).**

Hurdles:

- **Scholarly teaching is not the same as good teaching – true transformation based on educational research requires a workload and reward structure similar to discipline research**
- **Find a good educational psychologist**

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ASU college of technology innovation
ARIZONA STATE UNIVERSITY

Scaffolding Anchors of Persistence: Teaming

Department of Engineering
Arizona State University
Odesma Dalrymple

Characteristics of the Engineering Department

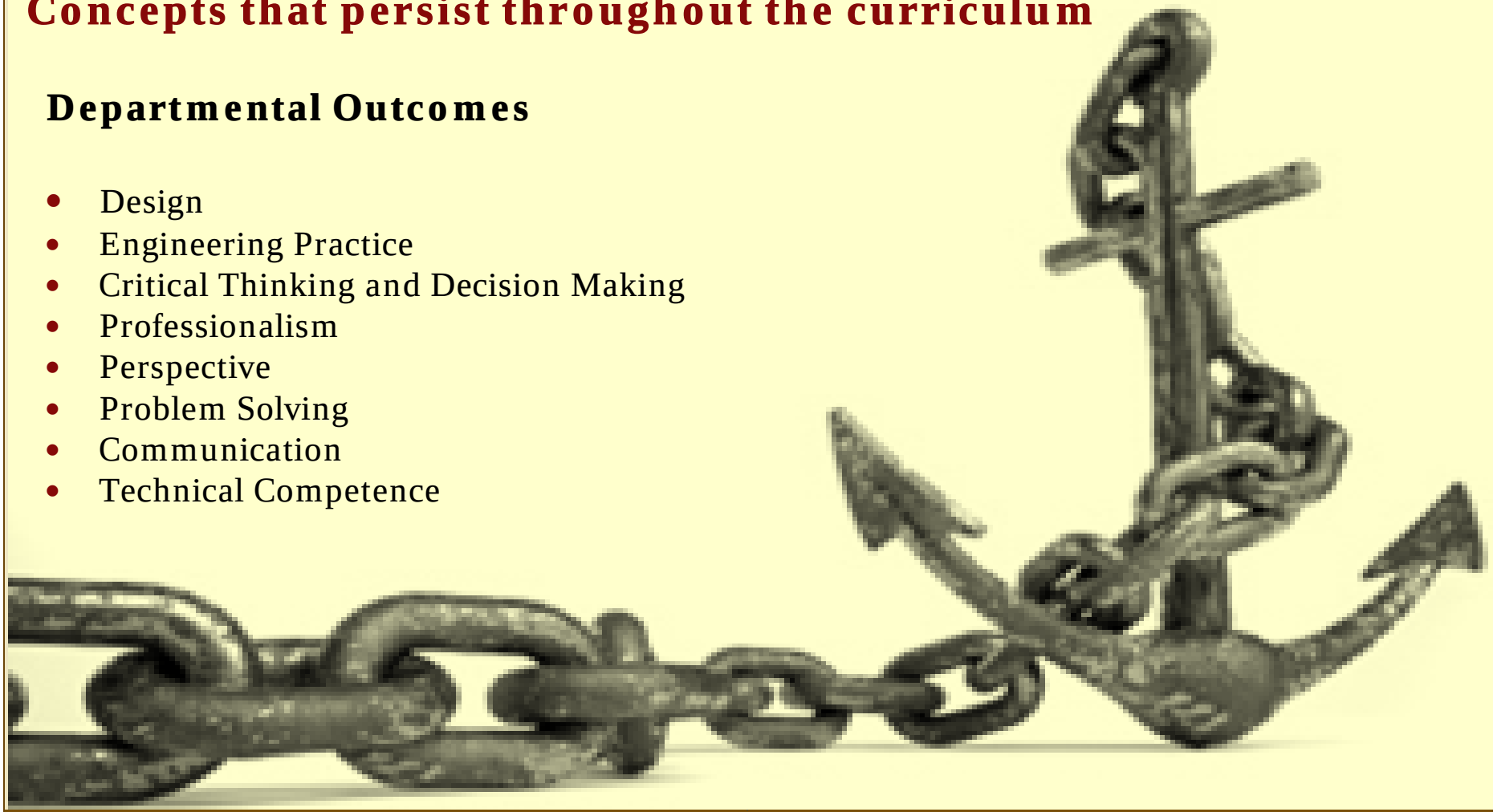
- Department is relatively new (<10 years)
- Inspired by the Alverno Model
- Offers a B.S. in Multidisciplinary engineering
- Solely undergraduate
- Project spine – Students engage in a project course every semester
- Hands-on learning / Relatively small classes (>40)
- Faculty focused delivering quality undergraduate education
- Well supported by the College-level and University-level administration

Anchors of Persistence

Concepts that persist throughout the curriculum

Departmental Outcomes

- Design
- Engineering Practice
- Critical Thinking and Decision Making
- Professionalism
- Perspective
- Problem Solving
- Communication
- Technical Competence



Teaming

Departmental Outcomes

- Design
- Engineering Practice
- Critical Thinking and Decision Making
- Professionalism
- Perspective
- Problem Solving
- Communication
- Technical Competence

Engineering Practice: Teaming

Level 1 – Can describe essential elements of engineering practice including **teaming**

Level 2 – Given an engineering problem, creates a plan and works within a **team** using the necessary engineering tools to produce a solution

Level 3 – Evaluates the effectiveness of the planning process, **teamwork**, and tool selection

Level 4 – Effectively adapts planning, **teamwork**, and tool use to achieve sounds professional practice and defensible solutions to problems

Teaming

Departmental Outcomes

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- Technical Competence

Goal: Develop teaming activities to scaffold through the Department of Engineering's project spine to help students achieve Level 2 in the Engineering Practice outcome.

Engineering Practice: Teaming

Level 1 – Can describe essential elements of **g**

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teamwork, and tool use to achieve sounds professional practice and defensible solutions to problems

Teaming Anchor of Persistence

Initial implementation focused on the first year

	Team Member Development	Team Processes and Strategies
First semester freshman (EGR 101)	Awareness of task oriented behavior (face to face and virtual) Awareness of own behavior (self reflection) Awareness of consequences of behaviors	Aware of team interpersonal processes
Second semester freshman		
EGR 102	Awareness of team member behavior Awareness of own behavior (self reflection) Awareness of consequences of behaviors	Aware of team action processes
EGR 104		Aware of team transition processes
Sophomore	Uses self awareness and knowledge to facilitate effective team performance.	
Junior and Senior	Integrates engineering and other contexts into the use of self awareness and knowledge to facilitate effective team performance.	

Strengths

- Utilized previously developed tools and resources
  - Alverno Task Oriented Team Behaviors framework
  - MEA material from Purdue University
  - CATME team maker and team effectiveness assessment
- Time was allotted (with pay) to work on the development of the initiative during the summer
  - Team of 6 faculty – 4 Assistant Professors / 2 Associate Professors (Including Chair of Department)
- Other faculty in the department helped to support the initiative when implemented in the curriculum

Challenges

- Assessments were performance focused and required significant faculty involvement to administer
  - Sustainability of that level of faculty involvement is questionable
- Many man- / woman-hours were expended in planning, development and deployment
  - Will an ongoing investment of that time be rewarded / recognized (P&T)?
- Scalability
  - Additional anchors through out the entire curriculum
  - Growing class sizes

QUESTIONS?

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