Supporting ALL Learners Using Active Learning Pedagogy

Jose Blackorby, Ph.D.
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Richard Eitel, Ph.D.
Join Active Learning Week
October 22–26, 2018
Agenda

➢ Introduction

➢ Multiple Stakeholder Presentations
  ➢ National Researcher
    ➢ Q & A
  ➢ Preparation Program Principal Investigator
    ➢ Q & A
  ➢ STEM Teacher Leader
    ➢ Q & A

➢ Closing
  ➢ Overall Q & A, Takeaways, Resources
About ARISE

The AAAS seeks to “advance science, engineering, and innovation throughout the world for the benefit of all people.”

Overarching ARISE Goal:

This project, organized by the American Association for the Advancement of Science (AAAS) Education and Human Resources Programs, seeks to provide resources, tools, and a community to foster research and evidence-based innovation in STEM preservice teacher education and leadership development programs for high-need schools.
About the ARISE Community Webinar Series

Focus on: Evidence-Based Transformative STEM Teacher Preparation

- intended to encourage engagement with current research and experimentation to advance knowledge and solutions to persistent challenges in STEM teacher preparation, particularly for high-need school districts.

OBJECTIVES

As part of ARISE's outreach strategy, this webinar series seeks to:

- collect and share information about topics and strategies for research and evidence-based approaches, and
- provide quality presentations and opportunities for attendee engagement.
Universal Design for Learning: Meeting the Needs of Today’s Diverse Learners

Jose Blackorby, Ph.D.
Director of Research and Development, CAST
Lecturer, Harvard Graduate School of Education (HGSE)

- **Affective Networks:** The Why of Learning
  - Engagement
    - For purposeful, motivated learners, stimulate interest and motivation for learning.

- **Recognition Networks:** The What of Learning
  - Representation
    - For resourceful, knowledgeable learners, present information and content in different ways.

- **Strategic Networks:** The How of Learning
  - Action & Expression
    - For strategic, goal-directed learners, differentiate the ways that students can express what they know.

ARISE
Advancing Research & Innovation in STEM Education of Preservice Teachers in High-Need School Districts

AAAS
National Science Foundation

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10/25/2018
Variability is even greater than we thought.
End of Average – Todd Rose
Jaggedness

SOURCE: The End of Average, Todd Rose
Jaggedness (con’t)

“If we design our instruction for the ‘average’ learner, we’re designing for no one.”

The Myth of Average
http://youtu.be/4eBmyttcfxU

SOURCE: The End of Average, Todd Rose
Context Matters
What is UDL?

Universal Design for Learning

**Recognition Networks**
The "what" of learning

How we gather facts and categorize what we see, hear, and read. Identifying letters, words, or an author's style are recognition tasks.

**Strategic Networks**
The "how" of learning

Planning and performing tasks. How we organize and express our ideas. Writing an essay or solving a math problem are strategic tasks.

**Affective Networks**
The "why" of learning

How learners get engaged and stay motivated. How they are challenged, excited, or interested. These are affective dimensions.
I. Provide Multiple Means of Representation

1: Provide options for perception
   1.1 Offer ways of customizing the display of information
   1.2 Offer alternatives for auditory information
   1.3 Offer alternatives for visual information

2: Provide options for language, mathematical expressions, and symbols
   2.1 Clarify vocabulary and symbols
   2.2 Clarify syntax and structure
   2.3 Support decoding of text, mathematical notation, and symbols
   2.4 Promote understanding across languages
   2.5 Illustrate through multiple media

3: Provide options for comprehension
   3.1 Activate or supply background knowledge
   3.2 Highlight patterns, critical features, big ideas, and relationships
   3.3 Guide information processing, visualization, and manipulation
   3.4 Maximize transfer and generalization

II. Provide Multiple Means of Action and Expression

4: Provide options for physical action
   4.1 Vary the methods for response and navigation
   4.2 Optimize access to tools and assistive technologies

5: Provide options for expression and communication
   5.1 Use multiple media for communication
   5.2 Use multiple tools for construction and composition
   5.3 Build fluencies with graduated levels of support for practice and performance

III. Provide Multiple Means of Engagement

7: Provide options for recruiting interest
   7.1 Optimize individual choice and autonomy
   7.2 Optimize relevance, value, and authenticity
   7.3 Minimize threats and distractions

8: Provide options for sustaining effort and persistence
   8.1 Heighten salience of goals and objectives
   8.2 Vary demands and resources to optimize challenge
   8.3 Foster collaboration and community
   8.4 Increase mastery-oriented feedback

9: Provide options for self-regulation
   9.1 Promote expectations and beliefs that optimize motivation
   9.2 Facilitate personal coping skills and strategies
   9.3 Develop self-assessment and reflection

Resourceful, knowledgeable learners

Strategic, goal-directed learners

Purposeful, motivated learners
<table>
<thead>
<tr>
<th>Access</th>
<th>Provide options for Recruiting Interest (8)</th>
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<tbody>
<tr>
<td>Build</td>
<td>Provide options for Sustaining Effort &amp; Persistence (9)</td>
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<tr>
<td>Internalize</td>
<td>Provide options for Self Regulation (9)</td>
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<tr>
<td>Goal</td>
<td>Provide options for Expert learners who are...</td>
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<td>Purposeful &amp; Motivated</td>
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<td>Resourceful &amp; Knowledgeable</td>
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<td>Strategic &amp; Goal-Directed</td>
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UDL in Action: SNUDLE for Science

Snudle
Science Notebook

CAST | Until learning has no limits | cast.org

@CAST_UDL | #UDL
Focus Question

Directions
Read the Focus Question!

Focus question:
Is flipping a coin a good way to decide who starts a game?
Flipping Coins - Collect Data

Directions
Gather data to decide if flipping a coin is a good way to decide who stays.

1. Each person flips a coin 5 times.
2. Record the number of "heads" and "tails" for each person.
3. Add the total number of "heads" and "tails" for the group in the bottom row.

1. Record the number of heads and tails.

Coin Flips Results

<table>
<thead>
<tr>
<th>Name</th>
<th>Column A: Heads</th>
<th>Column B: Tails</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student 2</td>
<td></td>
<td></td>
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<tr>
<td>Student 3</td>
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</tbody>
</table>
Flipping Coins > Analyze Data

Directions
Find patterns in your data!

How many total times was your coin heads up?
Write or speak  Draw  Upload  Create a table

How many total times was your coin tails up?
Write or speak  Draw  Upload  Create a table
SNUDLE UDL SUPPORTS

1) Select your SNUDLE doodle avatar.

2) Try drawing features, drawing such as clipart, drawing tools, and adding text to you.

@CAST_UDL | #UDL

Use these words!
cold front
map key
meteorologist
rain gauge
thermometer
warm front
weather
weather symbol
wind vane
How can the physical property of magnetism help us with grouping objects?

**Claim**
Based on my observation, we can use physical properties of magnetism to sort out magnetic or non-magnetic things. I can use a magnet to grab all the magnetic things and put it on one side and the non-magnetic things on the other side.

**Evidence**
One piece of data that proves my claim is my group and I used magnets and rulers to measure how long an object was. I used the magnet to get the magnetic objects or the non-magnetic objects and separated them from each other.

**Reasoning**
This proves that my claim is true because if you do the experiment you'll see that my evidence supports my claim because I did it before.

Reflect on your learning:
What is a strategy that helped you during this investigation? Something that helped me was a magnet because the magnet helped me find the magnetic objects.
Teacher Quotes: Benefits for Students

“It [SNUDLE] was very helpful for me, because they [my students] are bilingual and struggle with language. SNUDLE is very accessible and they figured it out very quickly (voice to text, sentence starters, etc.). [Using SNUDLE] Supported their language acquisition.”

Benefits of SNUDLE... “Accommodations are embedded – TTS, STT, a lot of students struggle in spelling – when they speak it they can see the word that they are trying to say. – they can verbally express what they think in science but couldn’t connect to the writing. Now, It is so helpful for teacher to see in writing what they are thinking.”

“For students who struggle, the drawing is a bonus, and using the sentence stems is a lifesaver. Initially [my students] didn’t realize they could use whatever they wanted, that they didn’t have to wait for a teacher to direct them about what to do in SNUDLE.”
Applying UDL in Higher Ed:
HGSE T-560 – Weekly 3 hours
Universal Design in architecture: essential for some, good for all

Universal Design for learning: essential for some, good for all

Educators are designers!
1st hour: Lecture/Presentation/Guest

- Provide background knowledge
- Address questions/comments from pre-class materials
- Frame key concepts for subsequent activities
- PowerPoint
  - Limit Text
  - Images
  - Video
Technology Helps

Poll Everywhere

- Plickers
- Padlet
- TodaysMeet
2\textsuperscript{nd} hour: Design Workshop

- Hands-on design activity
- Explore, examine, analyze, create
- Gain skills and ways of thinking that will support semester project

**Examples**
- Marshmallow Challenge
- Image Description
- Task Analysis
- Circuit Activity
- Journey Mapping
- Debate
- Escape Room
Workshops
Escape Room

Oh no! Double is Missing!!

Our robot was kidnapped by the Bell Curve Bandits! You need to find the password and the missing robot, then "hack" into the robot and drive him home to Gutman 303.
3rd hour: Section

- Flexible time
- Peer feedback on projects
- Discussion of readings and other materials
- Groups pursuing similar topics
Assignments

- Steps towards a Semester Project
- Reflections & Feedback
  - Text
  - Audio
  - Video
- Self Grading
  - Class Contributions
Semester Project

- **Goal**: An opportunity to put principles of UDL into practice
  - a prototype of an educational intervention or product, and
  - an accompanying paper that articulates the rationale for the design, drawing from content in the course.
Some Example Projects

- A new way of training officers in the marines
- A new way of teaching phonics and reading
- A nutrition program for BPS
- A mobile application for use in rural India
- Game for Language Learning

- A UDL approach to maker spaces
- A UDL design for museums
- A resource for exploring cultural identity
- Refugee Supports
- UDL for Meetings
- Prison education
- UDL for introverts
Impairment is socially determined, a cognitive-physical difference is just a difference until we make it an impairment.

Let’s strive to design learning environments where differences are differences and not impediments to learning...

Join us!

Lev Vygotsky
Contact for Further Information

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http://www.cast.org
Bring STREAM Education on Stream

Jiwon Hwang, Ph.D.
California State University, Bakersfield
Outline

1. Importance of STEM education in special education
2. Educational perspectives on STEM
   • Interdisciplinary approach
   • STEM >> STEAM >> STREAM
   • Development of lesson plan with integrative lesson objectives
   • Best practices for teaching students with disabilities for both pre- and in-service teachers
Importance of STEM Education

▪ What is STEM?
  • Generic label of a higher category spanning four areas
  • Refer to one or several areas of the four disciplines

▪ Importance of learning STEM discipline
  • Enhance the quality of daily life for students
  • Greater work-related opportunities
  • Prepares global leaders

▪ Crisis in U.S
  • Avoid majoring in STEM areas
  • Continuous difficulties
Educational Approach of STEM for Students with Disabilities

- Students with disabilities significantly struggle in STEM
  - Wide spectrum in academic and behavioral characteristics
  - Lack of motivation and self-confidence
  - “How to teach STEM in a curriculum effectively?”
  - STEM education needs to be reconceptualized
Educational Approach of STEM for Students with Disabilities (cont.)

- Ultimate goal of learning STEM disciplines

- Reconceptualization of STEM Education:

  an interdisciplinary approach when teaching between/among any two or more of STEM disciplines, or teaching any of the STEM disciplines integrated with other school subjects designed to prepare students to be equipped with the knowledge and skills to solve complex real-world problems

- Teachers should not only focus on STEM content knowledge ("what you know") but how students make good use of STEM knowledge ("what you can do with what you know")
Educational Approach of STEM for Students with Disabilities (cont.)

- Adding “Arts” for motivation
- Addition other subjects into integrative model
- Integrative thinking skills by the best practices to solve real-life problems
- A well-integrated knowledge base will benefit not only in students’ careers but also in the quality of their daily life
STREAM Education
Current Project: Bring STREAM Education on Stream

- The overall goal is to develop lesson plans that aligns math, science, and reading objectives with integration of technology and arts components to promote:
  - *math, science, and reading achievement*
  - *rich exposure to technology*
  - *generalization of math and science content knowledge and reading ability through hands-on activities*
  - *student motivation through arts integration*

- Lesson objectives are anchored in national standards and instruction uses an interdisciplinary approach, “STREAM”
Example of Integrative Lesson

**Fractions:** Developing understanding of fractions as numbers (CCSS.MATH.CONTENT.3.NF.A)

**Earth’s system:** read temperatures in fractions to understand weather conditions during a particular season (3-ESS2-1 Earth’s Systems)

**Informational text:** ask and answer questions to demonstrate understanding of a text regarding weather for four seasons (CCSS.ELA-LITERACY.RI.3.1)

**Arts**
- Playing instrument
- Visual representation
- Kinesthetic activity

**Technology**
- iPad
- Promethean/smart board
- Software programs

**FRACTIONS**
Resources


Contact for Further Information

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Experiences Implementing Active Inquiry and Engineering Design Curricula in Diverse Learning Settings

Richard E. Eitel, Ph.D.
Bryan High School
Omaha, Nebraska
Personal Background

B.S. Ceramic Engineering, Alfred University, 1998.


2006-2013: Assistant Professor, University of Kentucky, Lexington KY.

2013-2016: Teaching Associate Professor, Stevens Institute of Technology, Hoboken, NJ.
Personal “Discovery”
of Research Based Instructional Strategies

- University of Kentucky:
  - Mostly small <15 student Engineering Courses
  - Many First Generation College Students
  - Stand and Deliver with Individual Student Attention

- Stevens Institute of Technology:
  - 150 students per section (x2 Sections)
  - ~600 students annually
  - Immediate struggle to connect with students
The majority of engineering faculty are “aware” of research based instructional strategies (RBIS).

Over half of engineering faculty still rely on teacher centered approaches. Only 25% frequently use RBIS.

The VCP provided peer support through the study, development, implementation, and assessment of RBIS.
First Experience with Active/Inquiry in the Lecture Hall

Process Oriented Guided Inquiry Learning (POGIL)

**Guided Inquiry I: Crystals and Glasses:**
(5 minutes)

1. Which has the more ordered atomic arrangement of atoms; a crystal or a glass?
2. Use a ruler (or anything of fixed length like an ID card or piece of ruled paper) to estimate the average distance between atoms in the crystal parallel to the bottom of the page and along a diagonal. Are these average distances the same or different?

**Daily In-class Format**
- Brief Topical Intro (<5 minutes)
- Guided Inquiry Work in Teams (5-10 minutes)
- Review Inquiry (5 min)
- Formative Assessment (2 min)
  - Concept Check Questions
  - BYOD Poling (Learning Catalytics or Socrative)
- Repeat
  - ~3 POGIL cycles per 50 minute session
POGIL Results (Eitel, ASEE Proceedings, 2015)

- Immediate Increase in student Engagement and Persistence in Lecture
- Student Self Assessment compared to other courses.

![chart](chart.png)

- I practice critical thinking:
- I participate in in-class discussions:
- The course format has contributed to my interest:
- I am motivated to learn:

* Significant difference (N=194, p<0.01)
Training and Teacher Preparation

- Master Arts in Science Education, University of Nebraska-Lincoln
  - NSF Robert Noyce Stipend Recipient

- Research-Based Instructional Practices

- Strong focus on Implementation of Next Generation Science Standards

- Capstone Teacher Action Research Project
Teacher Action Research

Empirical study undertaken to help make decisions about specific problems in specific settings.

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<thead>
<tr>
<th>Purpose</th>
<th>Traditional Research</th>
<th>Action/Practitioner Research</th>
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<tbody>
<tr>
<td>Conclusion</td>
<td>Decision</td>
<td></td>
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<tr>
<th>Focus</th>
<th>Theory</th>
<th>Practice</th>
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<tbody>
<tr>
<td>Standard</td>
<td>Truth</td>
<td>Usefulness</td>
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</table>

Science Self-Efficacy and Engineering Design Practices in an Urban High School Science Classroom

[Diagram showing interactions between Teacher, Science Self-Efficacy, Scientific Investigation, and Engineering Design.]

- Teacher:
  - Plan
  - Focus
  - Revise

- Science Self-Efficacy:
  - Mastery Experience
  - Vicarious experience
  - Verbal Persuasion
  - Affective State

- Scientific Investigation:
  - Engage
  - Extend
  - Explore
  - Explain

- Engineering Design:
  - Challenge
  - Improve
  - Imagine
  - Create
Self-efficacy is the personal belief in one’s ability to successfully perform or complete a task (Bandura, 1977).

- Domain Specific

- Correlated with performance and persistence.

- Strongly biased by initial “anchoring.”
  (Tversky and Kahneman, 1974)
Support the development of science competency and pursuit of STEM careers by a more diverse community of learners.

“As the population grows and its needs and desires expand, the problem of sustaining civilization’s continuing advancement, while still improving the quality of life, looms more immediate.”  
(National Academy of Engineering, 2008)

“The understanding of, and interest in, science and engineering that its citizens bring to bear in their personal and civic decision making is critical to good decisions about the nation’s future.”  
(National Research Council, 2012)

Low self-efficacy in physics for female and minority students.  
(Cavallo, Potter, & Rozman, 2004; Lindstrøm & Sharma, 2011)
There is a strong case for the inclusion of engineering practices in science education:

- Link science to students’ daily experience.
- Science and engineering as a process.
- Opportunity for multiple feedback modes:
  - Authentic performance
  - Collaborative/Social
  - Vicarious Experience

(National Research Council, 2012)
How can engineering practices be used to support students’ achievement and persistence in science?

- On September 20, 2017 Hurricane Maria a Category 4 cyclone made landfall in Puerto Rico. Puerto Rico's aging power grid was largely decimated by hurricane Maria. As of Dec 29th, 2017 roughly 45% of Puerto Rico's residents were still without power.

- **Design Challenge:** Research, design, and build a safe, easy to use, and low-cost off-grid lighting solution to meet the needs of the residents of Puerto Rico until power can be restored.

(After: Schnittka, C. 2013)
Students completed an 8 week energy sequence including 5 90-minute design activities to build a gravity powered lighting solution.

(From: Schnittka, C. 2013)

https://teachergeek.com
Takeaways for My Current Teaching Practice:

- Self-efficacy survey has potential to identify individual students in need of extra supports.
  - Communicates to students my interest in their success

- Students may not have firmly developed a sense of science self-efficacy.
  - Provide both challenges and early opportunities for student success in science/engineering.
  - Multiple opportunities and modes of performance should be allowed to the extent possible.

- Engineering practices can be motivational and supportive of positive self-efficacy.
  - Scaffold engineering practices from first week of class.
  - Start with a clear assessment plan.
Works Cited


Schnittka, C.G. (2013). *Save the Snails, Salamanders, and Other Slimy Creatures.* Auburn University.
Contact for Further Information

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WEBINAR SUMMARY
Overall Q & A
Takeaways & Action Steps

In the Question panel, identify an action step you will take based on your participation today.
Webinar Key Points

- Learner Variability is even greater than previously believed.
- Affect, Motivation, and Context are central to learning.
- UDL is framework that can purposefully address learner variability and reduce barriers that is being used in K-12 as well as Higher Education contexts.

- STEM education breaks down the solid boundary among the disciplines and needs to be understood as an interdisciplinary approach when teaching any two or more of STEM disciplines integrated with other school subjects.
- Teachers should focus on how students make good use of their knowledge “what you can do with what you know” to increase students’ ability to apply their content knowledge to real-life situation.

- Action/practitioner research can be an effective way for teachers to formalize efforts to improve their own teaching practice.
- Engineering design experiences provide multiple modes of performance and engagement for diverse learners while driving home real-world applications of science content.
Resources

**RESOURCES**

**Supporting All Learners Using Active Learning Pedagogy**

WEBINAR HELD: Thursday, October 25 from 3:30 - 5:00 p.m. EDT

Shared by National Researcher - Dr. Jose Blackerby, CAST & Harvard Graduate School of Education:

  
- Tadis Talk: The Myth of Average by Todd Rose, co-founder and president of The Center for individual Opportunity. [https://www.youtube.com/watch?v=43myttq4U](https://www.youtube.com/watch?v=43myttq4U)
  

Shared by Preparation Program Principal Investigator - Dr. Jiwon Hwang, California State University, Bakersfield:


Shared by STEM Teacher Leader - Dr. Richard E. Eitel, Bryan High School - Omaha, NE:

- STEAP: STEM Learning and Research Center. NSF supported repository with numerous resources for classroom teachers and researchers including curricular materials, webinars, and research instruments. [http://steap.edc.org](http://steap.edc.org)

- Teacher geek: STEM storefront including versatile kits and resources for classroom engineering projects. The kits were the basis for my gravity light project. [http://teachergeek.com](http://teachergeek.com)

- Engineering4Youth: A collection of engineering design curricula developed by Christine Schmidtke at Autism University. The gravity light design project was taken from Dr. Schmidtke’s “Save the Snails” curriculum. [https://engineering4youth.weebly.com/curricula-i-designed.html](https://engineering4youth.weebly.com/curricula-i-designed.html)

Shared by the American Association for the Advancement of Science (AAAS):

- The K12 Empower project designing more accessible STEM learning activities—paper and concrete examples from an effort to examine how STEM resources could be made more accessible for students, regardless of what abilities they bring to the table. [http://www.k12stemeducation.info/JournalArticle/view/928261bF_4](http://www.k12stemeducation.info/JournalArticle/view/928261bF_4)

- The DO-IT (Disabilities, Opportunities, InterNetworking, and Technology) Center is dedicated to empowering people with disabilities through technology and education. [http://www.washington.edu/doit](http://www.washington.edu/doit)
Upcoming ARISE Webinar

Culturally Relevant Pedagogy in the Preparation of Teachers to Work in High-Need School Districts

Webinar: November 28 at 3:30pm EDT

Featuring:
Dr. Etta Hollins
Kauffman Endowed Chair for Urban Teacher Education at University of Missouri-Kansas City
Thanks to generous support from the National Science Foundation (NSF) under Grant No. DUE-1548986 - *Stimulating Research and Innovation in STEM Teacher Education*. Any opinions, findings, interpretations, conclusions or recommendations expressed in this material are those of its authors and do not represent the views of the AAAS Board of Directors, the Council of AAAS, AAAS’ membership or the National Science Foundation.
We Want Your Feedback

@NoyceProgram
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