Universal Design for Learning in the Science Classroom

Successful STEM Education Conference
San Francisco, CA – Feb. 1, 2016
Samantha Daley, EdD

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.

STEM Smart workshops are funded by the National Science Foundation grant #1449550. Any opinions, findings, and conclusions or recommendations at this event or in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
We need a model to let us consider this infinite variability...
Three major dimensions of how learners vary
Recognition Network: “what of learning”

Identify & interpret patterns of sensory information from the environment.
Strategic Networks: “how of learning”

Plan, execute, and monitor actions on the environment.
Affective Networks: “why of learning”

Evaluate & set priorities for attention and action
UDL Framework

1. Provide Multiple Means of Representation
   - Provide options for perception
     - Express information in a variety of ways
     - Offer alternative means of expression
   - Provide options for language and symbols
     - Offer multiple forms of symbols and linguistic representations
   - Provide options for comprehension
     - Offer multiple forms of comprehension

2. Provide Options for Action and Expression
   - Offer multiple options to engage in active learning
     - Offer multiple forms of engagement
   - Offer multiple options to express understanding
     - Offer multiple forms of expression

3. Provide Multiple Means of Engagement
   - Offer multiple options to enhance motivation
     - Offer multiple forms of motivation
   - Offer multiple options to support interest and involvement
     - Offer multiple forms of interest

CAST | Until learning has no limits
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
6: Provide options for executive functions
   6.1 Guide appropriate goal-setting
   6.2 Support planning and strategy development
   6.3 Facilitate managing information and resources
   6.4 Enhance capacity for monitoring progress

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
“Universal Design for Learning (UDL) means a scientifically valid framework for guiding educational practice that — (A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient.”

Every Student Succeeds Act (ESSA)
Fixed, uniform, learning technologies

Diverse, varied, learners.
The Result?

Children are the problem
New media changes the equations
An example

Science Notebooks

• Can effectively support active science learning and development of scientific literacy (Hargrove & Nesbit, 2003; Klentschy, 2005)
• Opportunity for students to engage in authentic scientific practice
• Support students to reflect, revise their thinking, focus on “big ideas”
• Provide formative assessment data for teachers
The nature of the task is critical
<table>
<thead>
<tr>
<th>I. Provide Multiple Means of Representation</th>
<th>II. Provide Multiple Means of Action and Expression</th>
<th>III. Provide Multiple Means of Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Provide options for perception</td>
<td>4: Provide options for physical action</td>
<td>7: Provide options for recruiting interest</td>
</tr>
<tr>
<td>1.1 Offer ways of customizing the display of information</td>
<td>4.1 Vary the methods for response and navigation</td>
<td>7.1 Optimize individual choice and autonomy</td>
</tr>
<tr>
<td>1.2 Offer alternatives for auditory information</td>
<td>4.2 Optimize access to tools and assistive technologies</td>
<td>7.2 Optimize relevance, value, and authenticity</td>
</tr>
<tr>
<td>1.3 Offer alternatives for visual information</td>
<td></td>
<td>7.3 Minimize threats and distractions</td>
</tr>
<tr>
<td>2: Provide options for language, mathematical expressions, and symbols</td>
<td>5: Provide options for expression and communication</td>
<td>8: Provide options for sustaining effort and persistence</td>
</tr>
<tr>
<td>2.1 Clarify vocabulary and symbols</td>
<td>5.1 Use multiple media for communication</td>
<td>8.1 Heighten salience of goals and objectives</td>
</tr>
<tr>
<td>2.2 Clarify syntax and structure</td>
<td>5.2 Use multiple tools for construction and composition</td>
<td>8.2 Vary demands and resources to optimize challenge</td>
</tr>
<tr>
<td>2.3 Support decoding of text, mathematical notation, and symbols</td>
<td>5.3 Build fluencies with graduated levels of support for practice and performance</td>
<td>8.3 Foster collaboration and community</td>
</tr>
<tr>
<td>2.4 Promote understanding across languages</td>
<td></td>
<td>8.4 Increase mastery-oriented feedback</td>
</tr>
<tr>
<td>2.5 Illustrate through multiple media</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Activate or supply background knowledge</td>
<td>6.1 Guide appropriate goal-setting</td>
<td>9.1 Promote expectations and beliefs that optimize motivation</td>
</tr>
<tr>
<td>3.2 Highlight patterns, critical features, big ideas, and relationships</td>
<td>6.2 Support planning and strategy development</td>
<td>9.2 Facilitate personal coping skills and strategies</td>
</tr>
<tr>
<td>3.3 Guide information processing, visualization, and manipulation</td>
<td>6.3 Facilitate managing information and resources</td>
<td>9.3 Develop self-assessment and reflection</td>
</tr>
<tr>
<td>3.4 Maximize transfer and generalization</td>
<td>6.4 Enhance capacity for monitoring progress</td>
<td></td>
</tr>
</tbody>
</table>

Resourceful, knowledgeable learners

Strategic, goal-directed learners

Purposeful, motivated learners

CAST | Until learning has no limits
Answer Focus Question

How can you make two lights burn brightly in a series circuit?

I connected a wire from the bottom of the D-cell to the bottom of the lightbulb. I added another wire from the side of the first bulb to the bottom of the second bulb. I connected another wire from the bottom of the second bulb back to the side of the D-cell.

10/28/2010
SNUDLE vs Traditional Paper Notebooks in inclusive 4th-grade science classrooms (n=621)

- There was a significant impact of SNUDLE ($\gamma = .34, p<.01$) use over and above that of traditional science notebooks – representing a 10% difference on average between treatment and control.

- SNUDLE raised the floor and the ceiling on content and process knowledge for all students

- Students of teachers who had more experience with science notebooking tended to use SNUDLE features more productively.
In their own words...

[video removed for permission reasons]
This content was produced under U.S. Department of Education, Office of Special Education Programs, Award No H327S150011. Michael Slade serves as the project officer. The views expressed herein do not necessarily represent the positions or policies of the U.S. Department of Education. No official endorsement by the U.S. Department of Education of any product, commodity, service, or enterprise mentioned in this website is intended or should be inferred.