Effective Science Teaching Strategies

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NWC 1350
In your opinion, what is the most effective teaching strategy that you have implemented as an instructor or that you have experienced as a student?

Why do you think that this strategy is effective?
Do you emulate what you remembered as being effective in your UG and GR experiences?

OR

Do you try to avoid what you remembered as being less effective in your UG and GR experiences?
One Strategy for Today

- **Before we begin**, learners can ask,
  - *What am I supposed to learn?*
  - *What prior knowledge will help me with this task?*
  - *What should I do first?*
  - *What should I look for in this workshop?*
  - *How much time do I have to complete this?*
  - *In what direction do I want my thinking to take me?*

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**Metacognition: Planning Phase**
How many students do you typically teach or will you teach in one class?

When poll is active, respond at PollEv.com/timothylauba025  📞 Text TIMOTHYLAUBA025 to 22333 once to join

1-25: 50%
26-50: 50%
What type of seating arrangement is in the classroom where you primarily teach?

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- Traditional
- Roundtable
- Horseshoe or Semicircle
- Double Horseshoe
- Group Pods
- Pair Pods
What is YOUR purpose of education?

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The purpose of this assessment probe is to elicit students' ideas about climate. The probe is designed to find out whether students distinguish between weather and climate.

What would be your next instructional move?
Students either collect or access weather data over several days or weeks.

Students graph temperature data.

Students compare the temperature data with long-term climate averages where they live.

What would be your next instructional move?
Students use evidence from secondary data and information to support or refute their claims from the ENGAGE activity to explain the difference between climate and weather.

The instructor supplements students’ explanation with additional content (as required)
Students use their new understanding to better understand the foundations of climate science by reading additional journal articles or trusted websites.

What would be your next instructional move?
Students create an "Is it climate or weather?" informational pamphlet to demonstrate their ability to distinguish between climate and weather.
Compare and Contrast this Instructional Sequence to Traditional Teaching/Learning
Some examples of traditional instruction:

- lectures
- note-taking
- reading assignments
- problem sets
- labs with specific instructions and a predetermined result

FACT: Traditional teaching methods have trained many STEM [science, technology, engineering, and mathematics] professionals, including most of the current STEM workforce.

Is your teaching focus on student memorization or conceptual understanding?

President’s Council of Advisors on Science and Technology (2012) report Engage to Excel
Evidence-Based Teaching Methods

- A large and growing body of research indicates that STEM education can be substantially improved through a *diversification of teaching methods*.

- These data show that *evidence-based teaching* methods are more effective in reaching ALL students—especially the “underrepresented majority”—the women and members of minority groups who now constitute approximately 70% of college students. (p. i)

President’s Council of Advisors on Science and Technology (2012) report *Engage to Excel*
More time engaging students in ACTIVE LEARNING during class

Frequent FORMATIVE ASSESSMENT to provide feedback to students and instructor on students’ level of conceptual understanding

Attention to students METACOGNITIVE STRATEGIES as they strive to master course material

Active Learning Strategies

- Making Lectures More Interactive
  - Think-Pair-Share
  - Peer Instruction
  - Ongoing adjustments to lecture based on formative assessment
  - Alternating lectures with interactive exercises
    - Clicker question
    - ConcepTests
    - Interactive lecture demonstration
    - Group Problem Solving
    - Min-Labs
    - Other types?

Active Learning Strategies

- **Student-to-Student Interactions**
  - Cooperative Learning (more structured)
  - Collaborative Learning (less structured)
  - Jigsaw techniques
  - Group work on problems, experiments, and projects
    - POGIL
  - Cooperative Problem Solving
  - Problem-Based Learning
  - SCALE-UP Model
  - Modeling Instruction

Active Learning Strategies

- Supplementing Instruction with Tutorials
- “students know HOW to do things, but they may not UNDERSTAND them”
- Elicit-Confront-Resolve

During the monitoring phase, learners can ask,

- How am I doing?
- Am I on the right track?
- How should I proceed?
- What information is important to remember?
- Should I move in a different direction?
- Should I adjust the pace because of the difficulty?
- What can I do if I do not understand?

Backward Design in Lesson or Unit Development

- Stage 1: Identify DESIRED OUTCOMES (learning goals)
- Stage 2: Determine ACCEPTABLE EVIDENCE of learning
- Stage 3: Develop LEARNING EXPERIENCES and ACTIVITIES

McTighe and Wiggins (2012)

An effective teaching and learning model

- Learners ENGAGE with an interesting phenomenon and make visible their initial explanation and reasoning
- Learners EXPLORE their ideas in context of phenomenon
- Learners attempt to EXPLAIN the phenomenon
- Learners ELABORATE on their explanation by applying it to other situations or phenomenon
- Learners EVALUATE their understandings and skills

BSCS 5E Instructional model at https://bscs.org/bscs-5e-instructional-model
- **Beyond Penguins and Polar Bears: Comprehensive List of Meteorology Misconceptions**  
  [http://beyondpenguins.ehe.osu.edu/issue/category/professional-learning/misconceptions](http://beyondpenguins.ehe.osu.edu/issue/category/professional-learning/misconceptions)

- **Children’s Misconceptions About the Weather: A Review of the Literature**  

- **Meteorology Misconceptions – The New York Science Teacher**  

- **10 Common Myths And Misconceptions About The Science Of Weather**  
Metacognition: Evaluating Phase

During the evaluating phase, learners can ask,

- How well did I do?
- What did I learn?
- Did I get the results I expected?
- What could I have done differently?
- Can I apply this way of thinking to other problems or situations?
- Is there anything I don’t understand—any gaps in my knowledge?
- Do I need to go back through the task to fill in any gaps in understanding?
- How might I apply this line of thinking to other problems?

(Fogarty, 1994)

Resources

BSCS 5E Instructional model at https://bscs.org/bscs-5e-instructional-model


Society for College Science Teachers (SCST) http://scst.org
Questions, Comments, Concerns

Thank You!

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