Using the 5E Lesson Model to Promote Mathematical and Scientific Thought

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Traditional Instruction

▪ Consider sitting in a “traditional” mathematics classroom learning about the Pythagorean Theorem for the first time...

...what might this look like?

▪ What is effective about the traditional method?
▪ What is ineffective/needs improvement about the traditional method?
Non-traditional Instruction

- Partial demonstration...
- What is effective about this presentation?
- What is ineffective/needs improvement?
Learning Science and Math

▪ In what ways can we create lessons that will engage your students in the process of being a scientist or mathematician while they learn the respective content?
Learning Science and Math

If all mathematics teachers work to implement one or more of the Standards for Mathematical Practice throughout their lessons, students can grow to become great mathematical problem solvers.

Similarly, if all science teachers work to implement inquiry-based lessons (using the NGSS), then more students can learn to become better problem solvers.

Consequences → Students can apply these skills to the world around them.
The Common Core

The Standards for Mathematical Practice

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning
The Next Generation Science Standards

- **Framework for K-12 Science Education** – released by the National Research Council on July 19, 2011

- This research-based report identified what science all K-12 students should know

- Related to teaching and learning, “the Framework emphasizes that learning about science and engineering involves integration of content knowledge and the practices needed to engage in scientific inquiry and the knowledge of scientific thought and engineering design.”

- With this emphasis, the framework sets out to show how knowledge and practice must be intertwined in K-12 science instruction.
The Next Generation Science Standards

Science and Engineering Practices from Framework

- Asking questions and defining problems.
- Developing and using models.
- Planning and carrying out investigations.
- Analyzing and interpreting data.
- Using mathematics, information, computer technology, and computational thinking.
- Constructing explanations and designing solutions.
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information.
Components of the 5E Lesson Model
Engagement:

- Grab learner’s attention, identifies misconceptions, assesses prior knowledge, promotes thinking, and raises questions.
- Makes connections to prior knowledge.
- Disrupts the students’ equilibrium.
- Provides a framework for the lesson.
- Human nature strives to create order and certainty - i.e. find the solution with the remaining E’s.
- Capturing student interest will promote self construction and students will be more willing to explore and attempt new material.

Sell the lesson to the students!
Exploration:

- Pose questions that allow students to test ideas
- Allow students to work together and take charge of their own learning
- Use critical thinking to solve problems
- Teacher is merely the facilitator of student interaction and uses effective scaffolding techniques to guide student interactions.
- Students are working in collaborative groups to form and construct new knowledge.
- Students should be working in their Zone of Proximal Development.
Explanation:

- Students share results
- Teacher guided discussion
- Results are clarified and misconceptions are corrected
- Creates meaning of the lesson and correlates directly with engagement and exploration therefore allowing proper construction of knowledge.
- Supported by the Cognitive Learning Theory which states that “knowledge that is constructed depends on the learners’ prior knowledge” (Eggen & Kauchak p. 197).
- Teacher is explaining and making connections to the content closely related to lecture base instruction.

So what really happened?
Elaboration:

▪ Displays deep conceptual understanding

▪ Content is more challenging

▪ Students apply knowledge to new contexts which displays deep conceptual understanding.

▪ The students are increasing meaningfulness of everything they have learned thus far; therefore, making the likelihood of encoding (or representing information) in their long term memory.

▪ Elaboration supported by the Constructivist Learning Theory which states that “meaningful learning occurs within real-world tasks” (Eggen & Kauchak p. 233)

Apply what we already know to other contexts.
Evaluation:

- Formal or Informal
- Check for comprehension
- Can occur at different points in the lesson
- Teacher assures the objectives are properly assessed in the evaluation since they are directly linked.
- Evaluation ensures instructional alignment so that the evaluation will be effective and minimize student confusion.
- Teachers have the opportunity to form self reflective practices or the practice of conducting a critical self-examination of one’s teaching (Eggen & Kauchak p. 5)

Assess what knowledge the students have gained.
Why 5E?

- Takes into consideration the different learning styles. i.e. hands on learner, auditory, etc..
- Student-focused learning rather than teacher-focused
- Easily allows checkpoints for comprehension
- Sets up for inquiry in the classroom
- Increases intrinsic motivation (students driven by a “need to know”)
- Facilitates collaborative learning
- Provides opportunities for critical thinking
Take a moment...

• Think of a lesson you have been a part of as a learner or teacher…

  ...what might the engagement and exploration look like?
Is it feasible? Myths???

- Resources
- Time
  - Students have to be “trained” to do the 5E???.
  - Fitting an entire 5E lesson into one day???
- Content
  - Teachers cannot cover as much content???
- Ideas
  - Teachers have to teach an entire 5E lesson everyday???
  - Teachers have to reinvent every lesson???
Concluding Thoughts

- How does a 5E lesson engage your students in the process of being a scientist or mathematician while they learn the respective content?
References


- Common Core Standards

- Next Generation Science Standards

- The Biological Science Curriculum Study (BSCS), a team led by Principal Investigator Roger Bybee, developed the instructional model for constructivism, called the "Five Es". Other models have been adapted from this model including the 6E and 7E models. http://www.bscs.org/