Leveraging Science Education’s 5E Learning Cycle: Designing Online Instruction to Uncover and Challenge Misconceptions

Presented as part of the 2020 OLC Accelerate Conference

Matthew Vick, Ph.D.
Interim Associate Dean of Graduate Studies
Professor of Curriculum and Instruction

UNIVERSITY OF WISCONSIN WHITewater
Session Goals

• Explain the learning science behind each of the 5Es
• Explain the learning science behind the order of the 5Es
• Distinguish between the purpose of the Explore and Elaborate activities
Session Goals

- Select or design appropriate virtual Exploration and Elaboration activities
- Select or design appropriate physical but distance education examples of Exploration and Elaboration activities
CONCEPTUAL CHANGE THEORY

KEY POINTS
Conceptual Change

• Students’ initial ideas about how the world works are so difficult to change

(e.g. Driver Guesne, & Tiberghien, 1985; Driver, Squires, Duck, & Wood-Robinson, 1994; Posner, Strike, Hewson, & Gertzon, 1982)

• References Link: https://tinyurl.com/y4d3lzcy
• Preconceptions of learners about scientific concepts seem reasonable to them in some situations, but they then generalize them to situations in which they do not work

(Anderson & Smith, 1987; Driver et al., 1985; Driver et al., 1994).
• These ideas are resistant to change (Wandersee, Mintzes, & Novak, 1994)

(Anderson & Smith, 1987; Driver et al., 1985; Driver et al., 1994).

• Conceptual change theory has found that learners change their ideas only when their initial ideas are not able to explain a new event or phenomenon. They need to discover alternatives that are plausible and useful.

(Hewson & Thorley, 1989)
Conceptual Change

- Explanations provided to learners that use sound scientific reasoning are unlikely to change learners’ preconceptions (Songer & Linn, 1991) because misconceptions are embedded in a particular context which requires students to alter other concepts as well (Strike & Posner, 1992).
• Presentation of anomalous situations (also called “discrepant events”) does not change misconceptions by themselves because learners often ignore the event or change their perception of the data

(Mason, 2001)
Conceptual Change

Conditions necessary for conceptual change:

– The learner must become dissatisfied with their current concept
– the new concept needs to be **intelligible** by learners
– it needs to be **plausible** in terms of resolving learner dissatisfaction
– it needs to be **fruitful** by being useful in other situations (have predictive power)

5E Model (Bybee, 1997)

1. **Engage**: Motivate and determine background knowledge

2. **Explore**: Test out current thinking/examine new phenomena

3. **Explain**: Dialog to connect exploration to content knowledge

4. **Elaborate**: Apply knowledge in a new situation

5. **Evaluate**: Were learning outcomes met?
Remember ABC... “Activity Before Concept”

Don’t rush to do the “explanation” before the exploration

(Phrase attributed to Arthur Eisenkraft)
5E Model (Bybee, 1997)

Explain doesn’t mean lecture

Explanations can vary and involve:

• Students sharing their conclusions
• Dialog about the concept between students
• Dialog about the concept between students and the teacher
• Dialog about the concept between students and written material
Elaborate doesn’t mean more instructor talk, introducing more vocabulary and ideas, or reading about the concept.

Elaborate does mean **applying** the new knowledge in a new situation.

- The exploration can be repeated with new conditions
- A situation that requires using the new knowledge can be presented.
Choose
Sample 5E Lesson

Engage

This Photo by Unknown Author is licensed under CC BY-SA

This Photo by Unknown Author is licensed under CC BY-SA

This Photo by Unknown Author is licensed under CC BY-NC-ND
Investigation Question: How do mass and pendulum length affect the time it takes for a pendulum to swing and return to a starting point?
Sample 5E Lesson

**Explain:** Use discussion board to share results and explain the effect of mass and pendulum length on the period of motion.

**Elaborate:** Find a combination of mass and length to create a specific period of ____s.
Evaluate:

Submit a written response to: “How does the Apollo 15 demonstration relate to the results of the pendulum experiment?”
This same lesson could be planned to use at-home supplies rather than the pHET simulations.

Explore and Elaborate activities could involve creating pendula of different lengths with different weights (use washers) and measuring the period.
BRAINSTORMING EXPLORATION AND ELABORATION ACTIVITIES
Brainstorm Activity

Join the Google Doc: https://tinyurl.com/y4wgbyog

Brainstorm activities/concepts that can be done as virtual or at-home Explore/Elaborate progressions.
Session Evaluations & Drawing

- Download and open OLC Conferences mobile app
- Navigate to specific session to evaluate
- Select “Evaluate Session” on session details screen (located under session type and track)
- Complete session evaluation*

*Each session evaluation completed (limited to one per session) = one contest entry

Five (5) $25 gift cards will be awarded to five (5) individuals
Must submit evals using the OLC Conferences mobile app or website