Collaborative Learning in STEM Education

Theory and Practice

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2017-06-02

Collaborative Learning: Theory

Overview

In a few minutes, outline your answers to the following questions:

- What happens when someone “learns” a scientific idea?
- What does it mean to “know” something?

Collaborative Learning: Theory

Constructivism

- Constructivism has been conceptualized in several ways, but all versions contain a few basic properties:
  - Knowledge is actively constructed by the individual.
  - The role of cognition is to organize one's experiential world.
  - The process of human interaction results in shared meanings.
- Because of the widespread adoption of constructivist points of view across settings, it is often presented more as a philosophy or worldview, rather than a specific theory.

Collaborative Learning: Theory

Piaget and Vygotsky

- For the purposes of argument, consider a couple of (broad) versions of constructivism in an educational setting:
  - **Piagetian constructivism**: Piaget focused educators on the "internally driven mental activity of the student", the construction of meaning and knowledge for oneself. Cognitive development proceeds in stages that are universal and predictable.
  - **Vygotskian social constructivism**: functioning in a group/society/culture, individuals negotiate and construct knowledge through discourse. The resulting knowledge is a *culture* of shared meanings.

Mustafa Cakir, Constructivist approaches to learning in science and their implications for science pedagogy: A literature review. *International Journal of Environmental & Science Education*, 3(4), 193–206, 2008.

Anne Howe, Development of science concepts within a Vygotskian framework. *Science Education*, 80(1), 35–51, 1996.

Collaborative Learning: Theory

Zone of Proximal Development

- A useful Vygotskian concept is the **zone of proximal development (ZPD).**
- The ZPD is the "gap" between what a learner can accomplish on their own and what they can accomplish with the support of a teacher/others.
- In the context of SEP-CyLE, this is useful to think about in two ways:
  - The Learning Objects on their own can help expand a student's ZPD.
  - The collaborative learning components may further expand the ZPD.

Anne Howe, Development of science concepts within a Vygotskian framework. *Science Education*, 80(1), 35–51, 1996.

Collaborative Learning: Practice

What can collaborative learning look like? An example.

Collaborative Learning: Practice

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- Students spend much of their time explaining to one another ("recognition opportunities").

Collaborative Learning: Practice

What can collaborative learning look like? An example.

- I don't lecture (ever).

Collaborative Learning: Practice

What can collaborative learning look like? An example.

- Students learn to figure out a lot of their own problems; take ownership over learning.

SEP-CyLE Activity

Backwards Design

- **Desired Outcomes $\Rightarrow$ Assessments $\Rightarrow$ Learning Activities**
  - **Desired Outcomes**: What core "enduring understandings" are desired?
  - **Assessments**: How will we know a student has developed these enduring understandings? What can they perform, solve, address?
  - **Learning Activities**: What activities, resources, and/or materials will help students to achieve the desired outcomes?

Grant Wiggins and Jay McTighe. "What is Backward Design?," in *Understanding by Design*, 7–19, 2001.

SEP-CyLE Activity

Designing LOs with collaborative learning in mind

- While engaging in the backwards design process, think particularly about what a team/group of students might do together (or virtually together) while working through your LO.
- Remember that student discourse is helpful, and may support learning more effectively than having them work an LO alone.

SEP-CyLE Activity

Designing LOs

- Get into groups (Peter arranged) based on LO topics.
- Begin the backwards design process by identify the desired outcomes of your LO (1-2 outcomes only – LOs should be short learning experiences!): 20 minutes
- We will then get back together to discuss.