What is Active Learning?
AND HOW DO WE KNOW IT IS EFFECTIVE?
Enough with the Lecturing

Active Learning Improves Grades, Reduces Failure Among Undergrads in STEM

---  NATIONAL SCIENCE FOUNDATION
MAY 2104
Lectures are linear and orderly.

Active mathematical thinking typically is not.
What we say/What they hear
What *they* say/what *we* hear

*Listening to our students*
What is Active Learning?

A variety pedagogical strategies that involve students in the development of (mathematical) concepts and help them to make (mathematical) connections for themselves.
Features

- **Student-to-student** communication is at least as important as teacher-to-student communication.
- Mathematical ideas are developed by means of **direct student engagement** in the material.
- Substantial class time spent in discussing the **mathematical insights of the students**.
Student work is supported by. . .

Carefully crafted materials that engage students in “sense-making activities” --- Tasks that require them to

<table>
<thead>
<tr>
<th>Solve problems</th>
<th>Explore</th>
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<tbody>
<tr>
<td>Conjecture</td>
<td>Create</td>
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<tr>
<td>Experiment</td>
<td>(and) Communicate</td>
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Mathematical Ideas.
In an active learning class, we . . .

. . . collectively develop the cognitive tools and structures necessary for individually making sense of the mathematical content.
Our role as teachers: support for students’ mathematical development and learning

Not to try to circumvent it by attempting to be brilliant for them.
“Evidence-based teaching strategies”
Large-scale study
comparing inquiry-based and non-inquiry-based courses
(Laursen et. al.--- University of Colorado)

found:

IB courses produced better results than parallel non-IB courses in

• Both cognitive and affective areas.

• Both within the semester of the IB course and in later courses, taught using inquiry or not.
Laursen et. al. (cont.):

The strongest gains were observed among women and students with prior weak achievement.

(Though learning gains were also statistically significant for students with the strongest prior achievement. Students “in the middle” did at least as well in IB as in non-IB courses.)
Strong and consistent evidence about the dual importance of individual engagement and collaborative learning processes” for student learning outcomes.

Large-scale study comparing IB and non-IB courses (Laursen et. al.) found:
Laursen et. al. ---Statistically Significant Results

Student learning outcomes are

- Positively correlated with the *fraction of class time spent doing student-centered activities*.

- and negatively correlated with the *fraction of class time spent listening to instructors talk*.

Similar positive and negative correlations were seen with the proportion of class time that was student- or instructor-led.
What’s Hard?

- Giving our students the **time** to really wrap their heads around a concept requires a lot of patience.

- Good materials are **crucial** to the success of the endeavor. And can be tricky to write.
What’s Hard?

(Apparent) loss of control in the classroom.

Developing a successful “learning community can be far messier than a command-and-control classroom.” ---Catherine A. Roberts in Perspectives on Modeling and Applications in a Service Learning Framework. In Mathematics in Service to the Community---MAA Notes #66.
What does an Active Learning Classroom Look Like?