

The first person to arrive at your table has a job.

- Look for an envelope containing colored cards and a piece of paper.
- Enter the requested information on the piece of paper, either a number or tally a “yes” or “no” for each question.
- When the proceedings begins, someone please add up the value in the “years teaching” category, and sum the tallies.



Research-based practices
in STEM education:
What's the research,
where is it from,
where is it taking us

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Dept. of Chemistry
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Fostering
Academic Success
in STEM,
Ctr Excellence &
Innovation in
Teaching and
Learning, Apr18

I started my life
as an analytical chemist.

Colorado State Univ. PhD Chemistry, 1979

*Nonmetal emission in helium
microwave plasmas*

I did research as an analytical chemist

Environ. Sci. Technol.	1981, 15, 783-8.
Anal. Chem.	1981, 53, 2020-2027.
Spectrochim. Acta B	1983, 38, 1125-1134.
Environ. Sci. Technol.	1985, 19, 1099-1103.
Anal. Chem.	1986, 58, 176-182
Anal. Chem.	1987, 59, 1417-1423.
Sci. Total Environ.,	1988, 68, 251-266.
Anal. Chem.	1988, 60, 2218-2220.

Co-authors:

Natusch, Skogerboe, Andren, Grant, Jenkins, Kheboian,
Wouters, Van Grieken, Linton

I taught as an analytical chemist

Quantitative Analysis

Instrumental Analysis

General Chem for Engineers

Spectrochemical Methods

Electrochemical Methods

Electronics

Statistics & Experimental Design

I make my lectures clearer every year,
but the students aren't
getting it better.

Students must be getting dumber.

I need to get smarter.

Where is the state-of-the-art?

Journal of Chemical Education wisdom

Young people are distracted with all the complexities of our modern life. Stone

Only a small percentage of our graduates will take more chemistry. Roe

It is not fair, he feels, if problems differ in the from those in the book. Wakeham

The average student in college freshman chemistry courses is arithmetically infantile.

Scott

Journal of Chemical Education wisdom

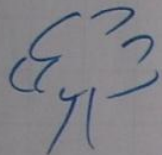
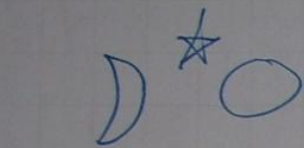
Young people are distracted with all the complexities of our modern life. **1924**

Only a small percentage of our graduates will take more chemistry. **1930**

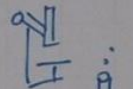
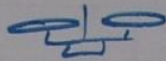
It is not fair, he feels, if problems differ in the from those in the book. **1934**

The average student in college freshman chemistry courses is arithmetically infantile.

1938



1906



SCIENCE

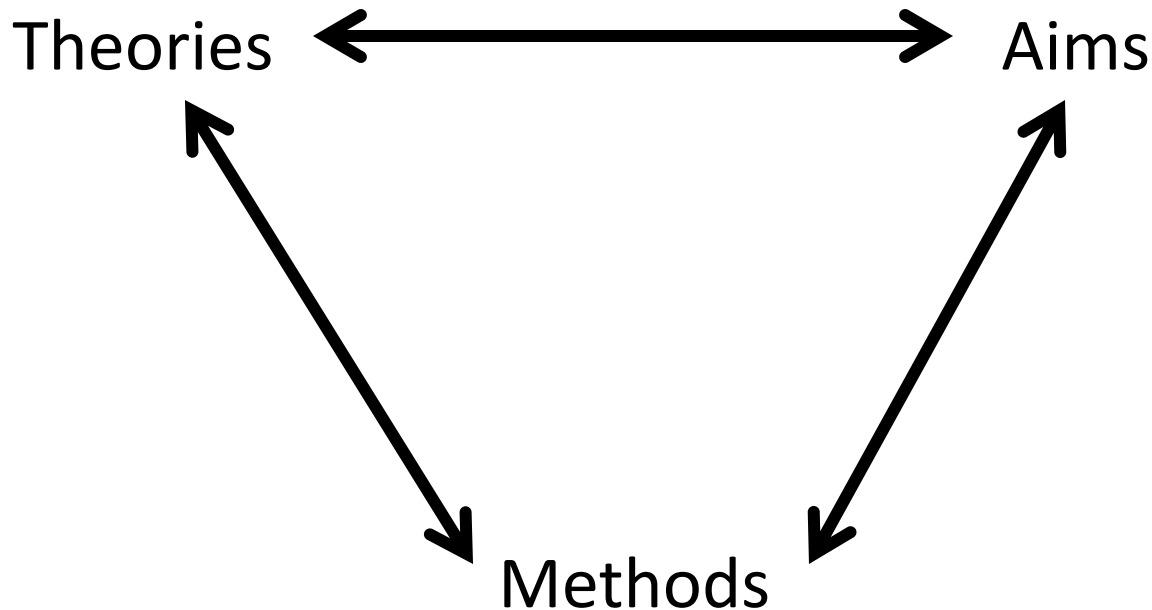


2000

SCIENCE
EDUCATION

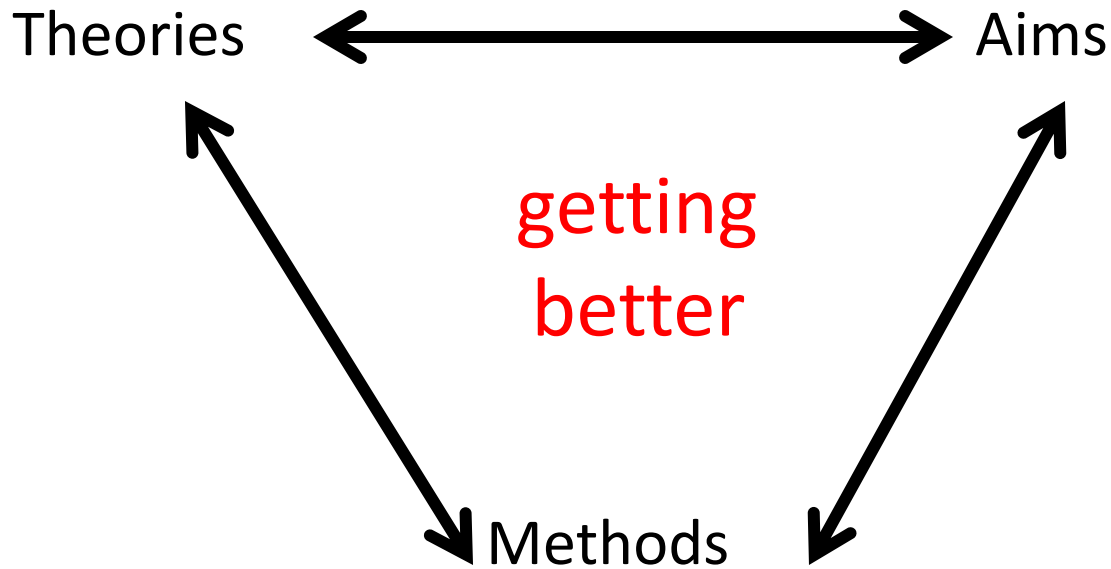


Laudan ('84), via Duschl ('90),
via Abrams & Wandersee ('95)



Triadic model for the growth
of scientific knowledge

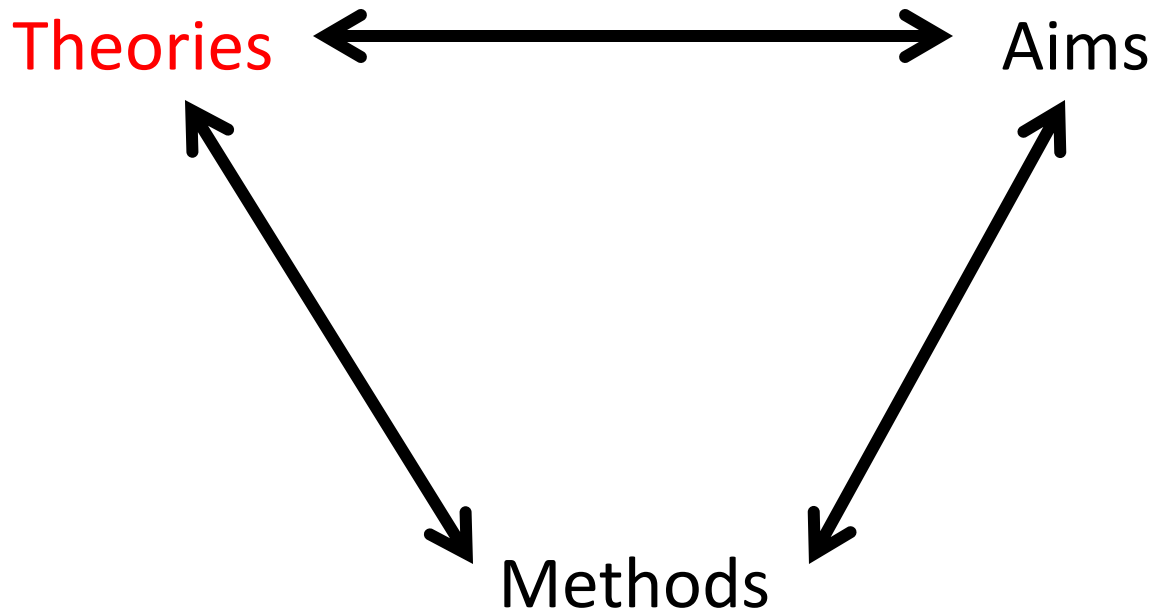
Laudan ('84), via Duschl ('90),
via Abrams & Wandersee ('95)



Triadic model for the growth
of **SCIENTIFIC EDUCATION** knowledge

- Web picture of children in canoe paddling in opposite directions

Laudan ('84), via Duschl ('90),
via Abrams & Wandersee ('95)



Triadic model for the growth
of scientific knowledge

If you want to get ahead, get a theory.

Karmiloff-Smith & Inhelder, 1975, *Cognition* 3(3), 195-212

Behaviorism

Constructivism

Developmentalism

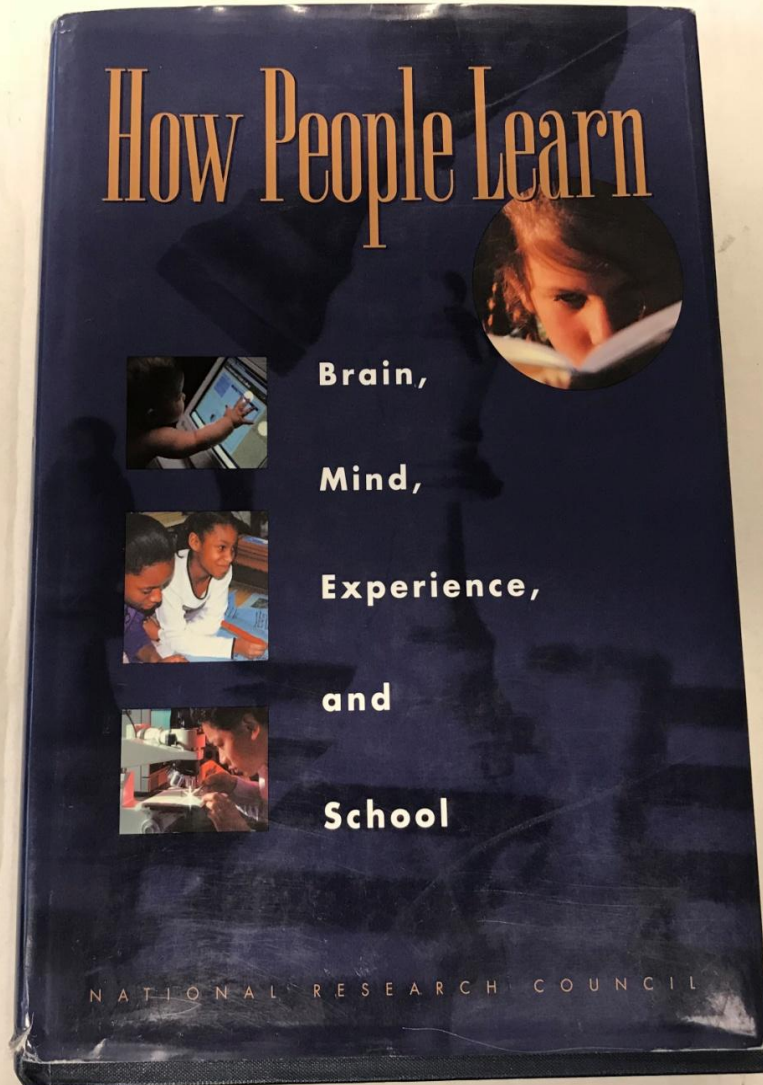
Meaningful learning

Attitudes and beliefs

Social constructivism

Cognitive motivation theory

Bransford, Brown, Cocking, et al.
National Academy Press, 1999



Hold up
Blue 7-8
Yellow 5-6
Green 3-4
Pink 0-2

What goes on inside students heads?

Cognition

- Constructivism
 - Knowledge is constructed within individual minds
 - Knowledge construction is mediated by social discourse
- Information processing, recognition, recall
 - Awareness and perception
 - Short-term memory capacity
 - Long-term memory structure
 - Pattern recognition

CBSVHFINCPHDETC

CBS V H F I N C P H D E T C

C T E D H P C N I F H V S B C