A Mathematics Teacher Educator's Personal Perspective of Research on Mathematics Learning

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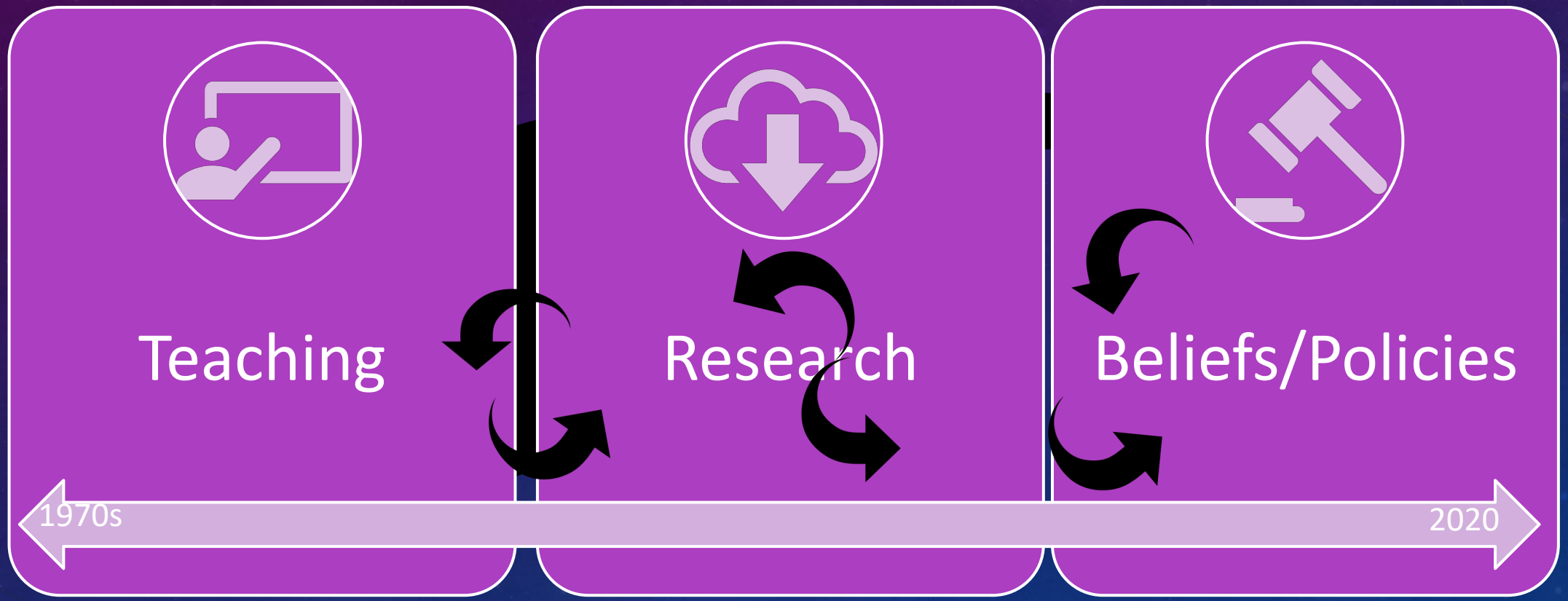
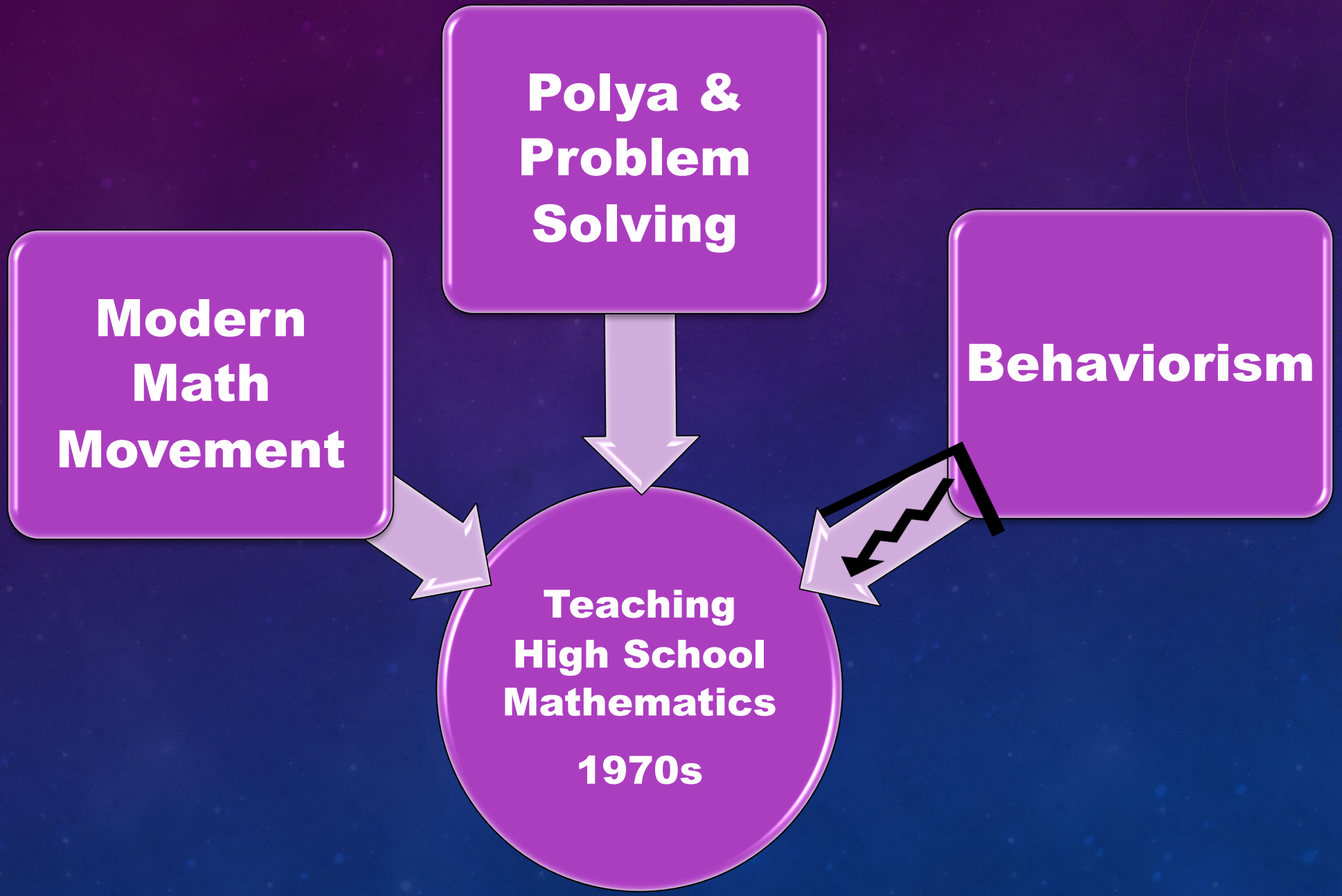
February 28, 2019

UNDERSTANDING HOW STUDENTS LEARN MATHEMATICS

RESEARCH ON MATHEMATICS LEARNING



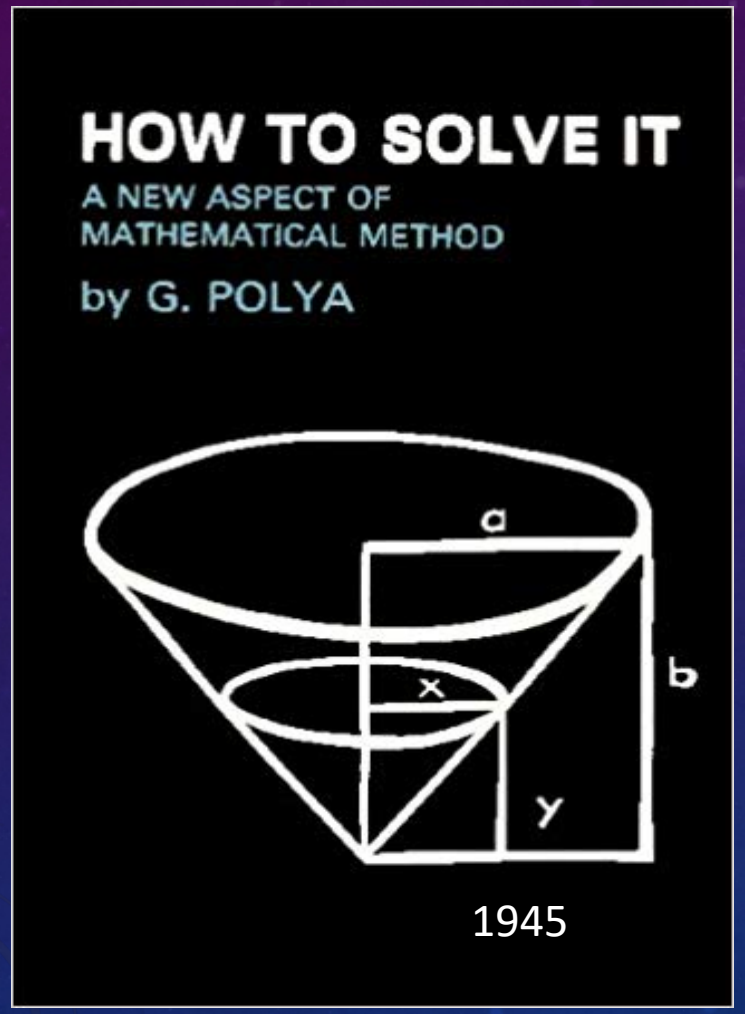

Polya & Problem Solving
Modern Math Movement
Behaviorism
Teaching High School Mathematics
1970s

MODERN MATH MOVEMENT

"Learning should not only take us somewhere, it should allow us later to go further more easily."

Jerome Bruner. (1962). *The Process of Education*

G. POLYA & PROBLEM SOLVING



Polya's #3

…

"Know about the ways of learning. The best way to learn anything is to learn it yourself."

…

Mathematical Discovery: On Understanding Learning and Teaching Problem Solving. (1965)

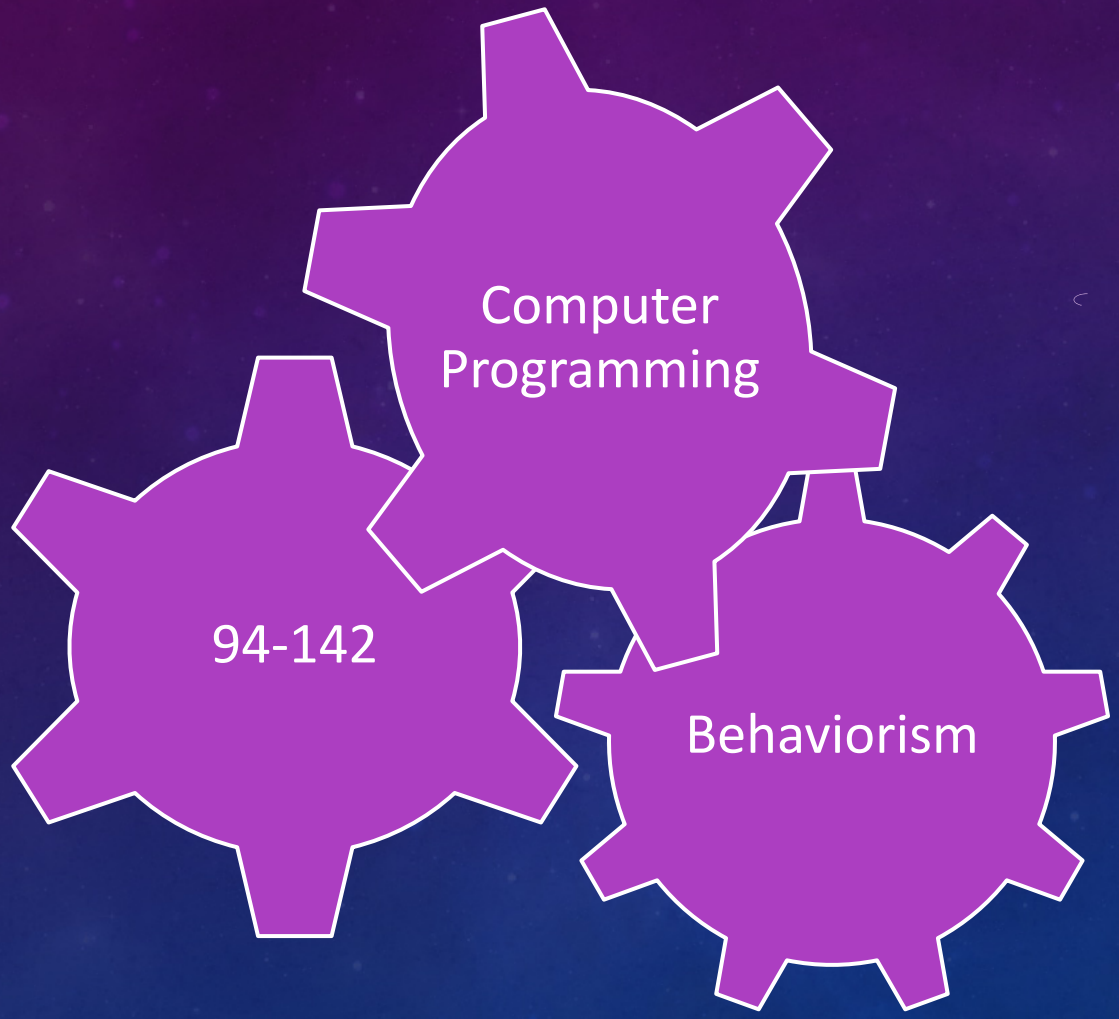
BEHAVIORISM IN THE MID 1970S

Back to Basics

Skinner, Gagne, & Bloom

Define learning in measurable terms.
Assessment connected to learning
Math clinics, founding of RCML, …
Diagnostic & prescriptive instruction; individualized instruction

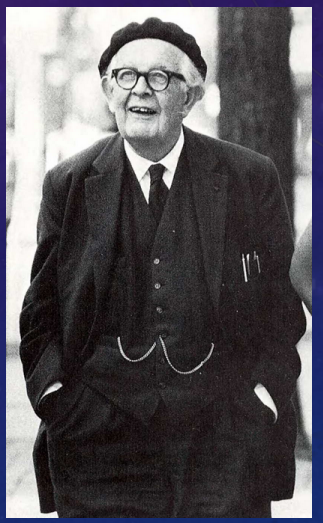
What is Mathematics?
What does it mean to do mathematics?


Computer Programming
94-142
Behaviorism

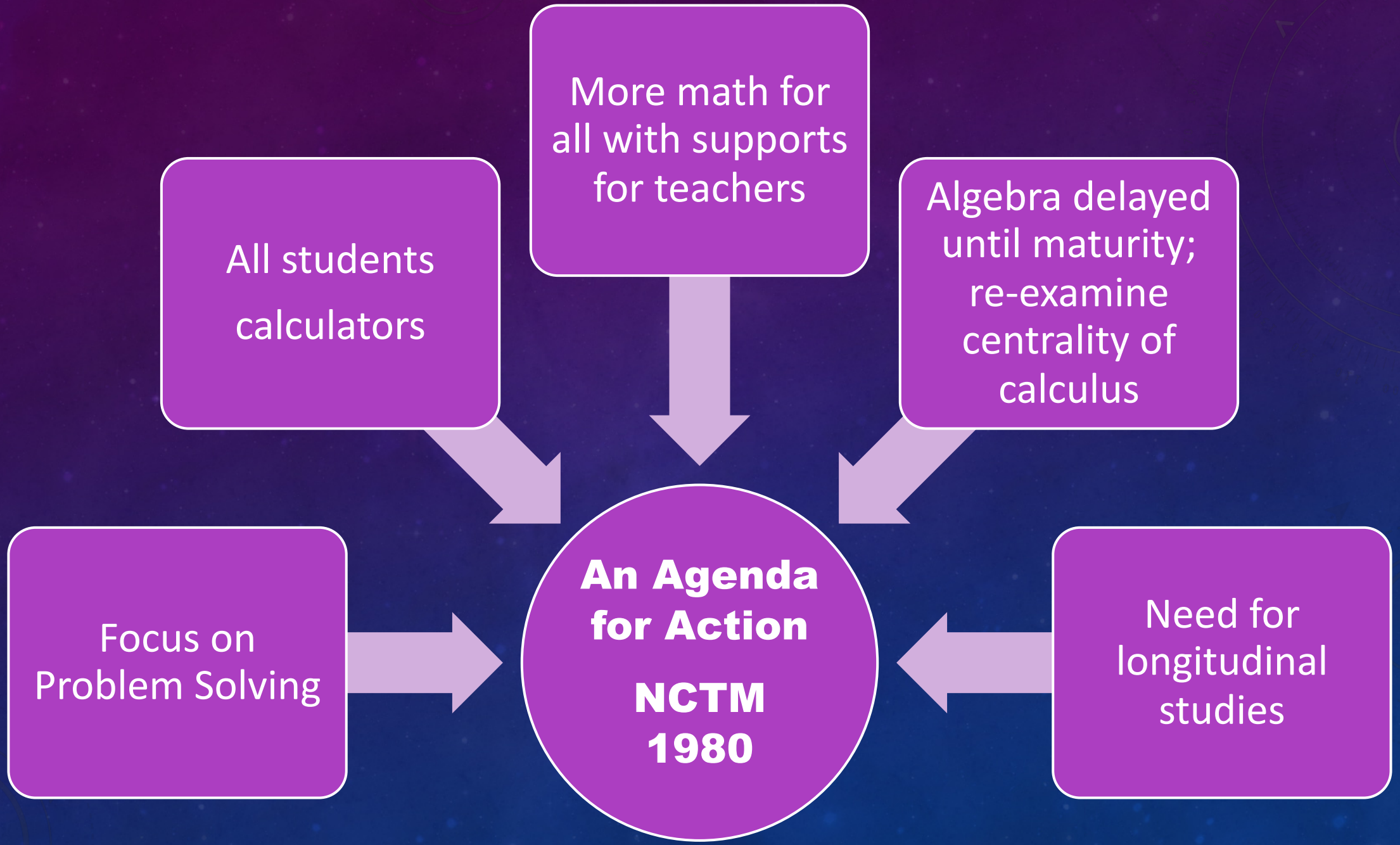
GROWTH OF LOGICAL THINKING

The Growth of Logical Thinking from Childhood to Adolescents

1955 (1958 in English)



Learning is the development of schemata through a process of disequilibrium, accommodation, and assimilation.


More math for all with supports for teachers
All students calculators
Algebra delayed until maturity; re-examine centrality of calculus
Focus on Problem Solving
An Agenda for Action
NCTM 1980
Need for longitudinal studies

MEANING/REPRESENTATION + DEVELOPMENT

Dienes **VanEngen** **Brownell**

Skemp **Kieren**

Harold Mick

Inhelder & Piaget **Noelting**

Development of Part-whole and Operator Subconstructs

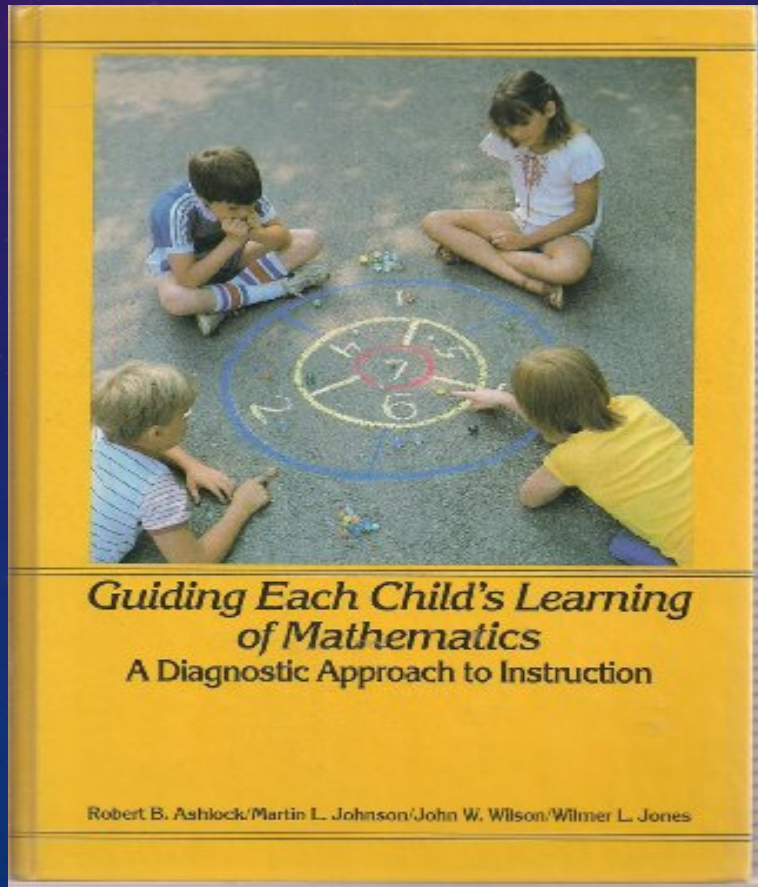
DIAGNOSTIC & PRESCRIPTIVE MATHEMATICS

RCML founding members:

Robert Ashlock

Martin Johnson

John Wilson



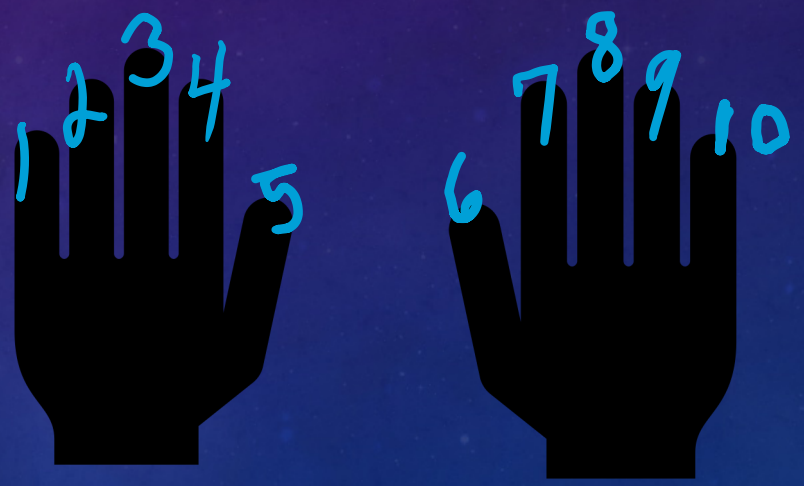
1983

DIVERSITY IN MATHEMATICS LEARNING PRIMARY LEVEL

Cuisenaire Rods to Finger Math

Cultural Differences Abound

Karen Fuson's Research



CURRICULUM & EVALUATION STANDARDS

Standards Based Curricula

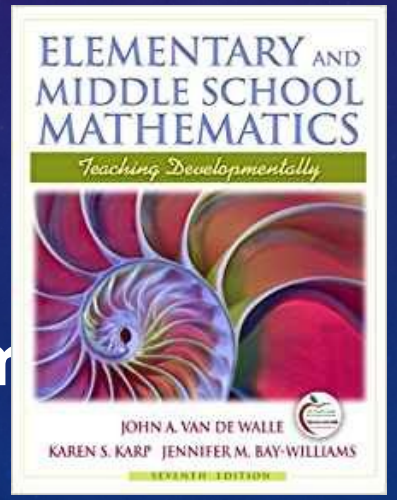
Cognitively Guided Instruction

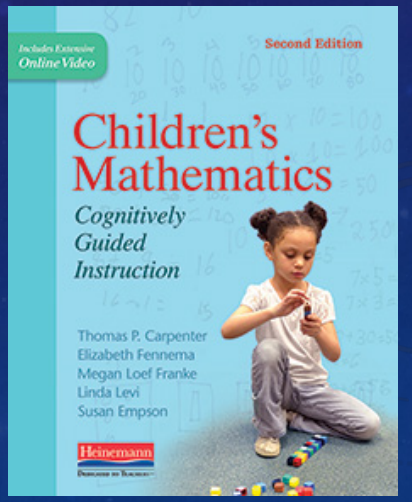
Technology as a mathematical tool and as a learning tool

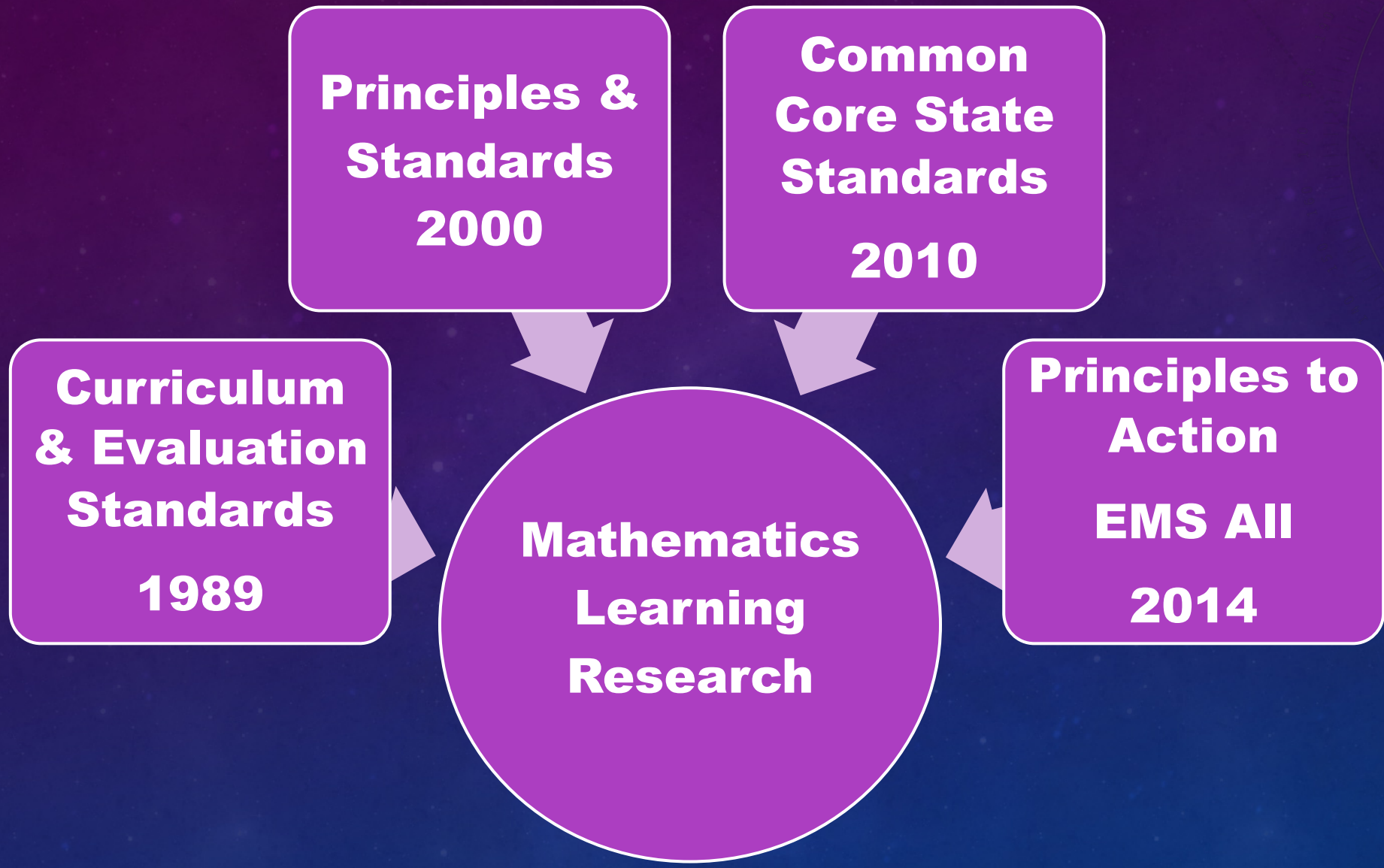
Making Connections

Teaching Developmentally

Van de Walle, Karp, Bay-William






Principles & Standards 2000
Common Core State Standards 2010
Curriculum & Evaluation Standards 1989
Mathematics Learning Research
Principles to Action EMS All 2014

…AND MORE ABOUT FRACTIONS…

Multiplication: “by “ and “of”

Paper folding and Drawing Area Models

Fraction Division Meanings

Math for Everybody, Everyone, for All

1977, National Center for Learning Disabilities

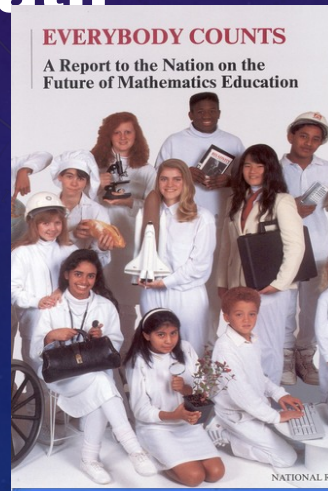
1974 & beyond, Elizabeth Fennema's Studies of Gender & Math

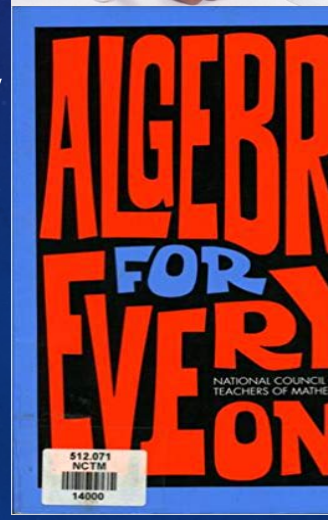
1989, *Everybody Counts*

1990, *Algebra for Everyone*

2013, *The Impact of Identity in K–8 Mathematics: Rethinking Equity-Based Practices*

2018, *Annual Perspectives in Mathematics Education 2018: Rehumanizing Mathematics for Black, Indigenous, and Latinx Students*





INTERACTIONS

...AND MORE ABOUT FRACTIONS...

problem solving process

…IN RETROSPECT…

- We know a lot about how students learn mathematics, but there is more to learn.
- Research on mathematics learning has affected what we teach and how we teach it, but there is much, much more to know and understand.
- We need theories to explain mathematical learning or lack thereof and frameworks by which we can study learning.
- We also need replications and small scale, small focus research on mathematical learning.

Mathematics education is a wonderful profession—undeniably important, rich and dynamic, with inspiring history and iconic members, and with a powerful pipeline of young and energetic new members.