

# A Connectivist Approach to Inclusive STEM Education

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**Ne'epapa Ka Hana Project** - a program to transform mathematics education for Native Hawaiian and diverse learners in the State of Hawaii  
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# Introduction

**Inclusive STEM** (Science, Technology, Engineering & Mathematics) education is not only **economic priority**, but also promising for closing the **STEM opportunity gap**.

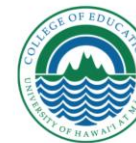
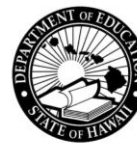
Research showed access to inclusive STEM education leads to higher **skill** acquisition, increased **achievement, inclusion in future environments** as well as higher **self-efficacy**, and **self-determination**.

Although the research attests the positive outcomes, inclusion in practice is **not well supported** for **mathematics** education, as a gateway to STEM programs, in terms of **inclusive content, accessible process, and flexible learning environments**.

NE  EPAPA KA HANA  
*Transforming STEM Education*

Narrow **STEM achievement gap**  
by helping **diverse learners** achieve  
success and engagement in **middle  
school mathematics.**

Use the **social learning  
technology** that provides a **socio-  
culturally responsive  
curriculum.**



# Challenges

Technology in Inclusive Mathematics Education (IME)



# How Technology Support IME

- Engage *all* students at a higher-level learning
- Promote a student-centered learning environment
- Adaptive learning content and media to personalize instruction
- Support self-regulation and self-monitoring
- Utilize collaborative learning to support cognitive processes
- Provide formative assessment prompts and quick personalized feedback

# Challenges

## Learning Process

Maintain attention | Give priority to conceptual understanding & mathematical thinking (vs. procedural) | Balance between classroom & online learning activities | Math anxiety | Cooperative learning ...

## Learning Environment

ICT literacy | Inclusiveness | Language & communication | Self-directed learning | Student agency | Self-esteem | Relationship among students ...

## Learning Media

Content relevancy | Accessibility | Emphasize on reasoning, connection, and communication | Transformability | Versatility | Networkability | Reproducibility | Assessment ...

# Connectivism

*A Theoretical Solution for 21<sup>st</sup> Century*



# Concept

- **CONNECTIVISM** is a learning approach that builds on the principles of constructivism to realize the learning potential of network technology.
- **CONNECTIVISM** proposes to see knowledge's structure as a network and learning as the ability to navigate, understand and expand a network of knowledge.
- **CONNECTIVISM** emphasizes the role of social and cultural context of learning networks.



# Principles

Learning as a social  
phenomenon

Diversity of opinions

Distributed  
knowledge

Ability to see and  
navigate  
connections

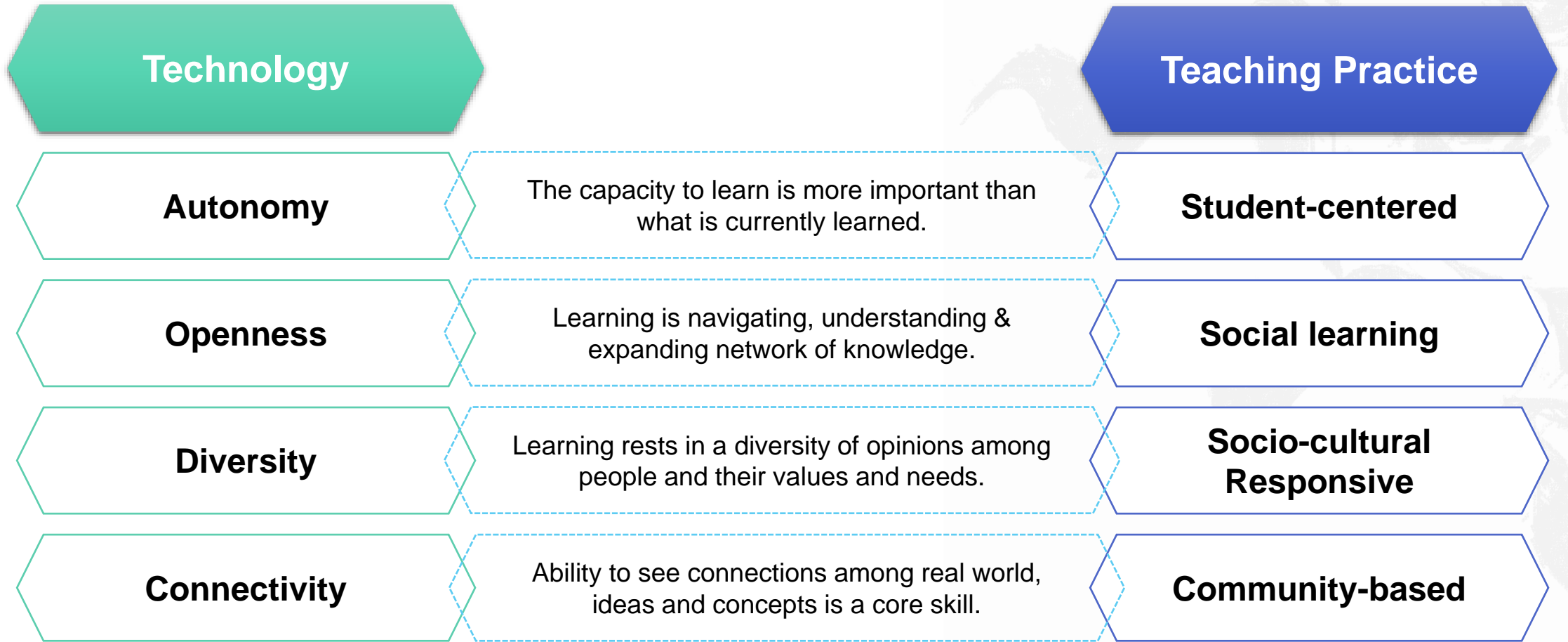
Nurturing and  
maintaining  
connections

Capacity to learn

# Promises for IME

- Facilitate inclusion
- Maximize engaged learning time
- Diversify learning contents and approaches
- Explore problems in different ways from multiple perspectives
- Provide additional practice opportunities with social feedback
- Teach additional 21st century learning skills and strategies

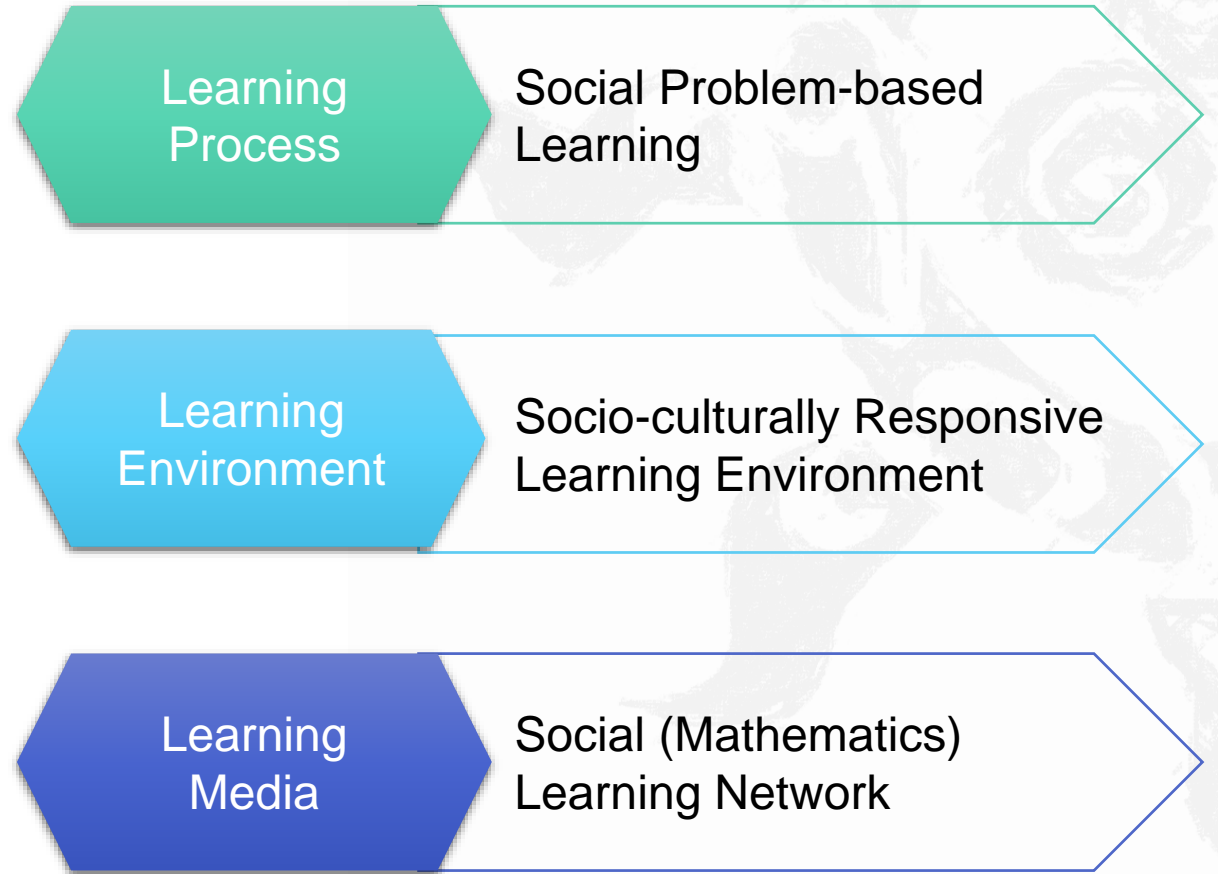
# Implementation



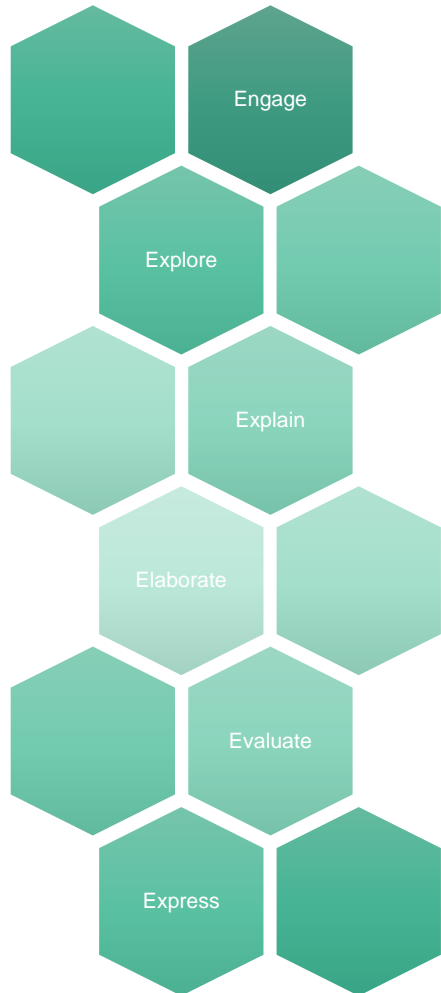
# NKH Model of Connectivism

How to adapt Connectivism in practice and address its limitations

# NKH Mathematics Teaching Model



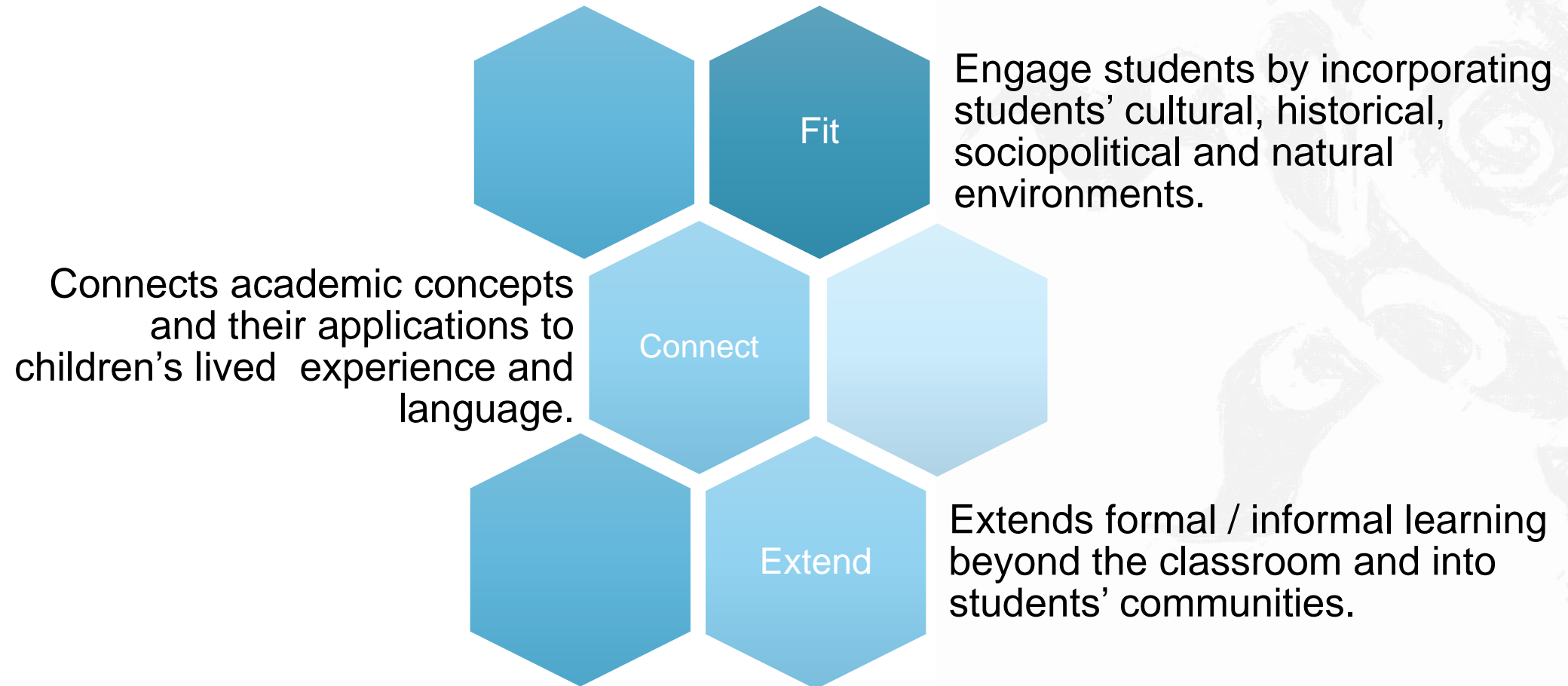
# Social Problem-based Learning



Allows all students including diverse learners to

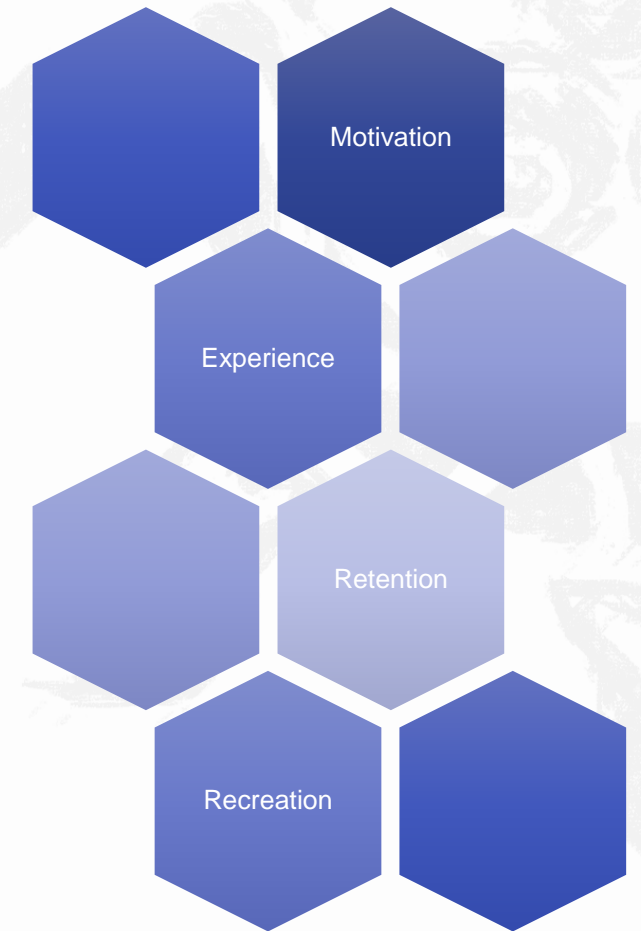
- make connections between concepts, ideas, and problems
- understand the applications and learning values
- make predictions by drilling (mathematical) concepts
- elaborate different aspects of problems using social network
- collaboratively test and evaluate hypotheses
- express and publically/socially present findings and solutions

# Socio-culturally Responsive Environment



# Social (Mathematics) Learning Network

- Highlight and celebrate diversity
- Social supports and social motives across schools
- Dynamic interested-based exchange (social) environment
- The social application of know-how and know-why
- Multiple opportunities for social validation of learning (e.g. community presentation)



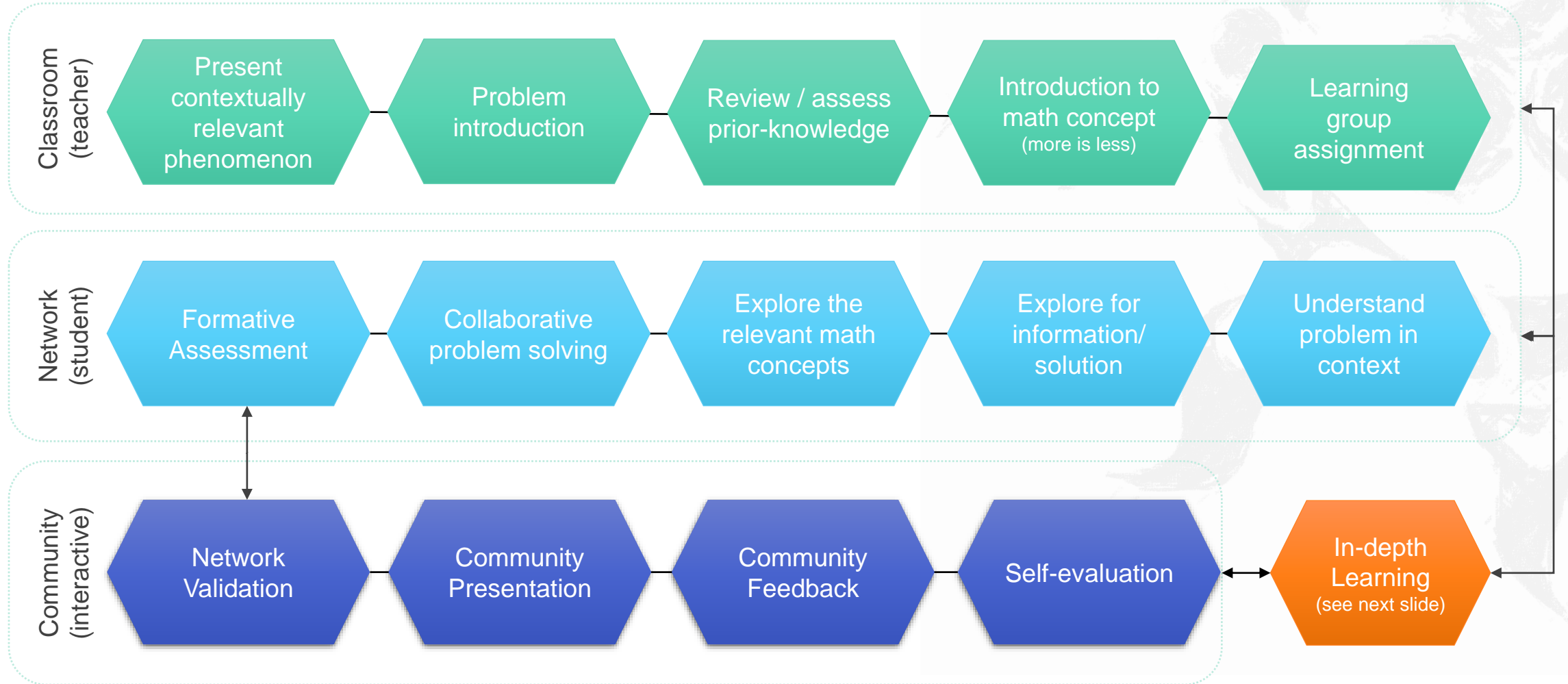


# Implementation

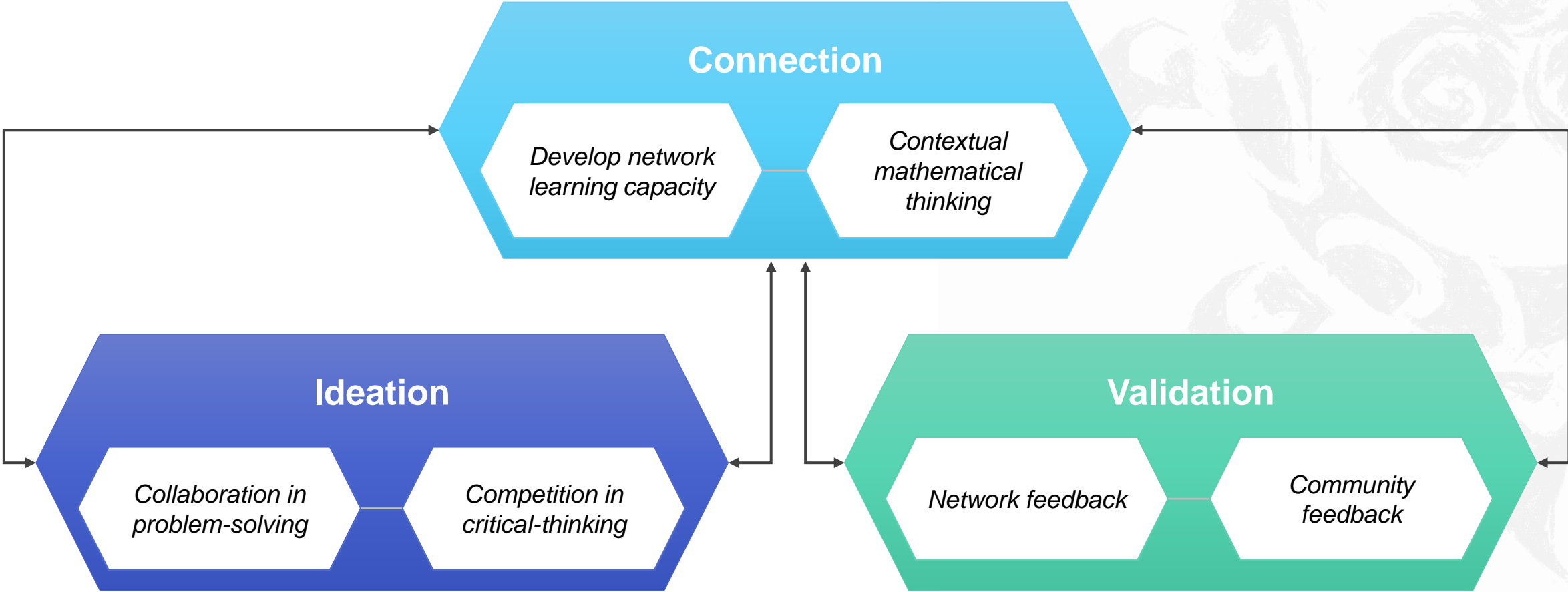
Design Components



# Implementation Organization



# Learning Process



# Implementation Outcomes\*

\* Based on the pilot study results – SY 2015-16

# Inclusive Network of Learners

- Diverse learners engagement in
  - Judgment-free learning environment
  - Organic higher-order thinking
  - More interaction opportunities
  - Network tutoring
  - More mathematics practice with indirect feedback
  - Flexible learning time

# Outcomes

## Cognitive Outcomes

- Knowledge
- Skills
- Mathematical thinking

## Affective Outcomes

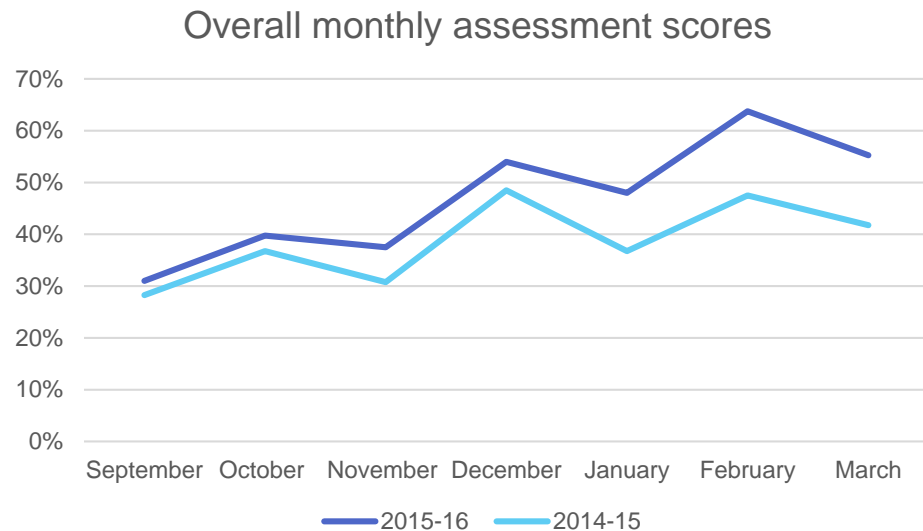
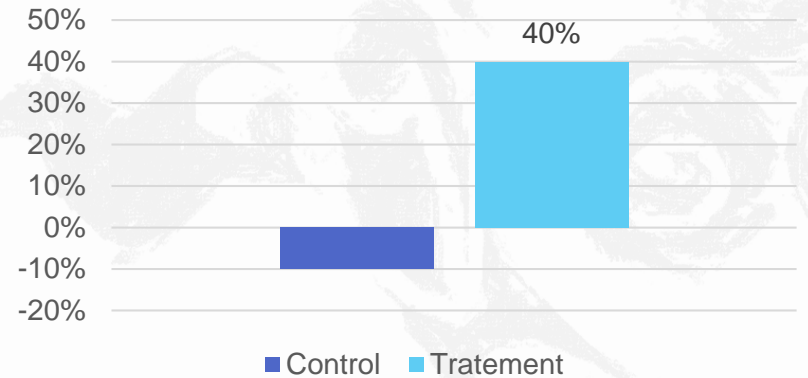
- Engagement
- Motivation
- Confidence

## Behavioral Outcomes

- Communication
- Collaboration
- Critical Thinking & Creativity

# Student Progress

- In a sample of 64 students, **40%** increase by one letter grade or more between this year and last school year.



- About **21%** increase in monthly assessment between this year and last school year.