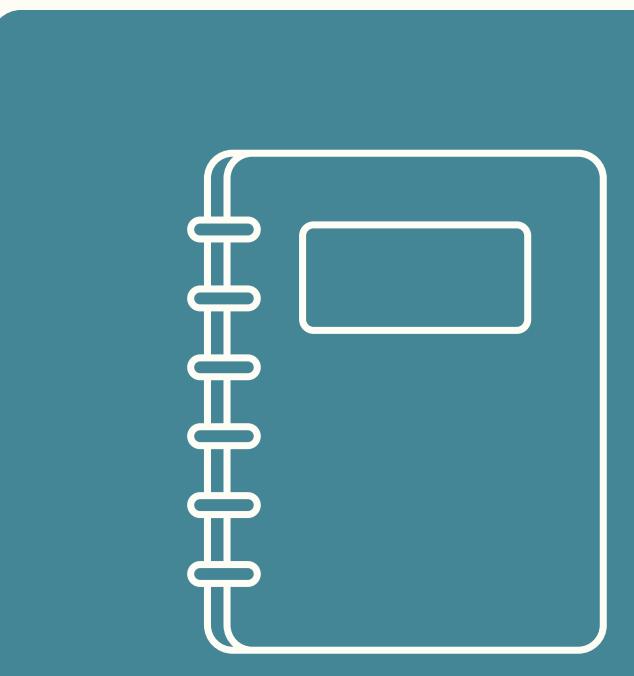
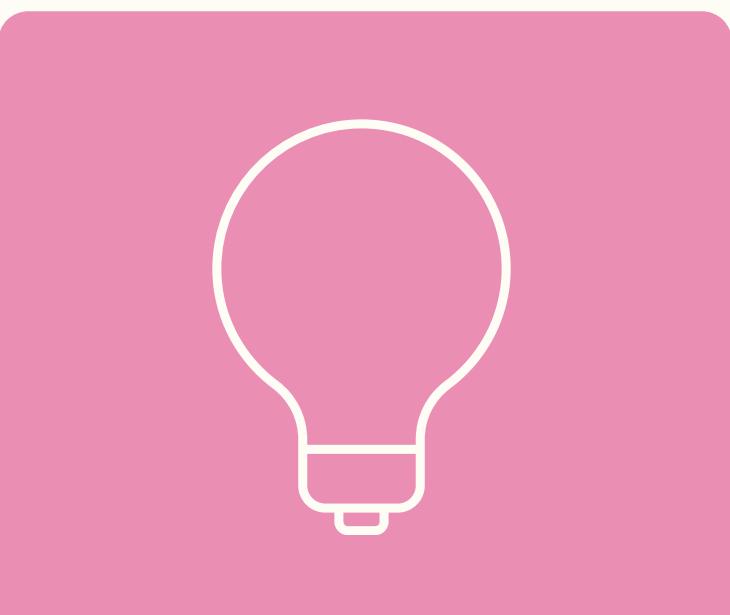
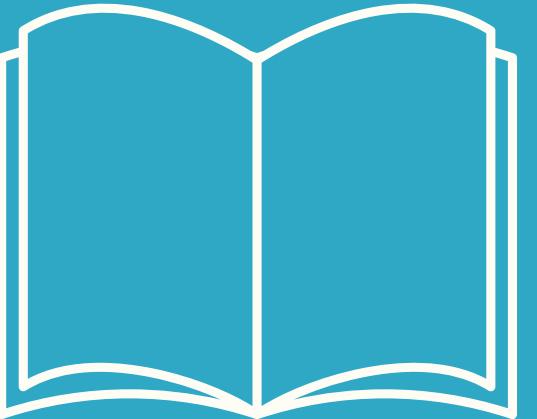




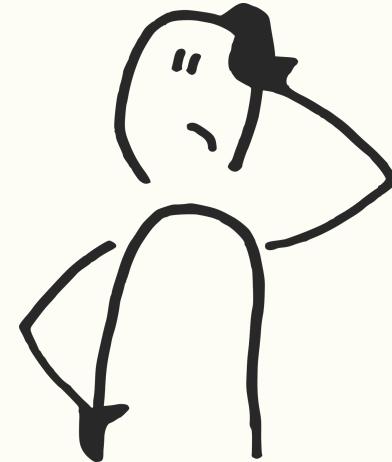
# Improving Conceptual Understanding of Forces through Peer Instruction

A Two-Cycle Action Research Based on FCI Diagnostics

Mary Gwadoline Yusus  
Shafiq Rasulan  
nov 2025



# Trouble in Mechanics



## Trouble

01

Persistent Misconception

02

Overemphasis on Formula-Based Learning

03

Limited Student Engagement and Interaction

## Impact

01

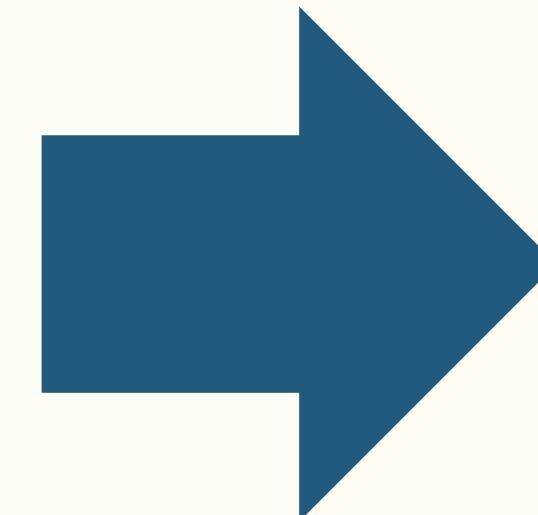
poor performance in reasoning-based physics problems

02

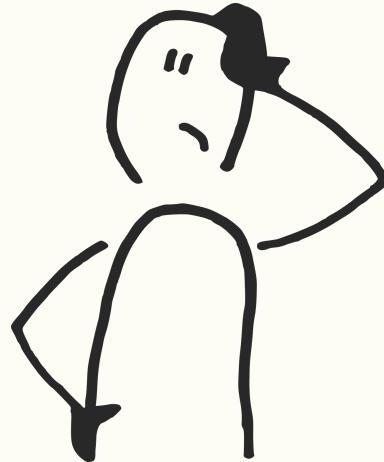
Learning becomes rote and fragile, shallow conceptual learning

03

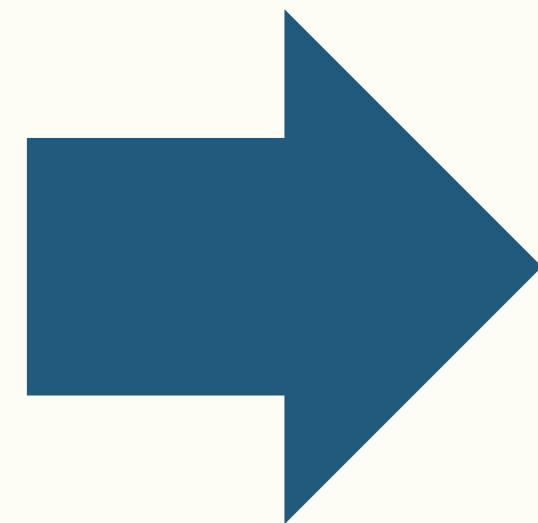
Low Self Efficacy



# Trouble in Mechanics



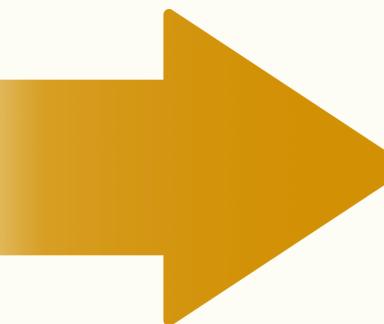
Proposed  
Solution?



Peer  
Instruction  
(Mazur's Method)



Target  
Group



**8 KMSW STUDENTS  
BASED ON EARLY  
DIAGNOSTIC DATA**



## ACTION OBJECTIVES

To improve students' conceptual understanding of force and motion through the implementation of Peer Instruction (Mazur's method) in classroom lessons.  
**(Goal: 80%)**



## RESEARCH OBJECTIVES

### QUANTITATIVE:

- To measure the conceptual gain between Diagnostic Test and Post Cycle 2 Test after each action research cycle.

### Qualitative:

- To explore students' experiences, perceptions, and self-efficacy in learning force concepts through Peer Instruction discussions.

# Why Mazur's Peer Instruction?



Promotes Conceptual Change through Cognitive Conflict.  
(Posner et al., 1982).

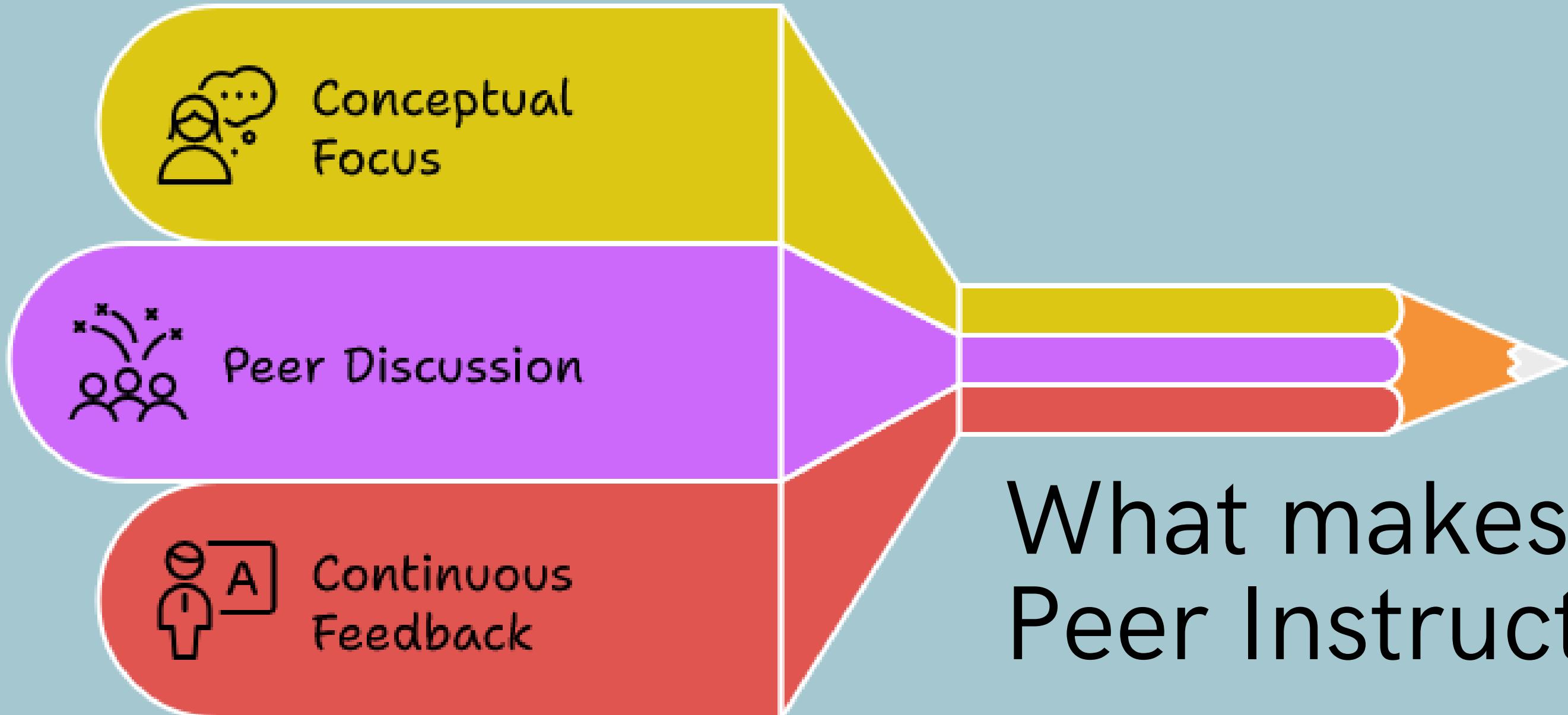


Enhances Learning through Peer Discussion and Social Constructivism.  
(Vygotsky, 1978)

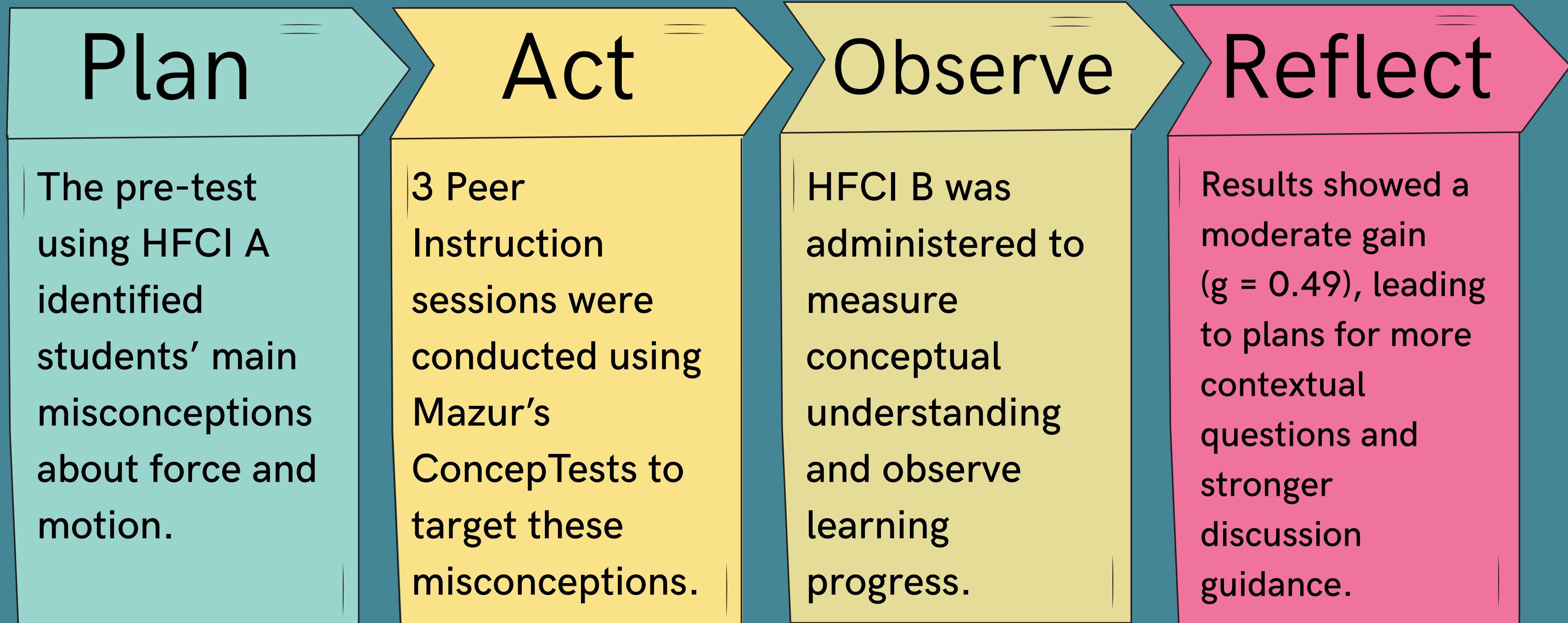


Proven Effectiveness in Increasing Conceptual Gains  
(Mazur, 1997; Crouch & Mazur, 2001; Hake, 1998)





# Action Research Cycle 1

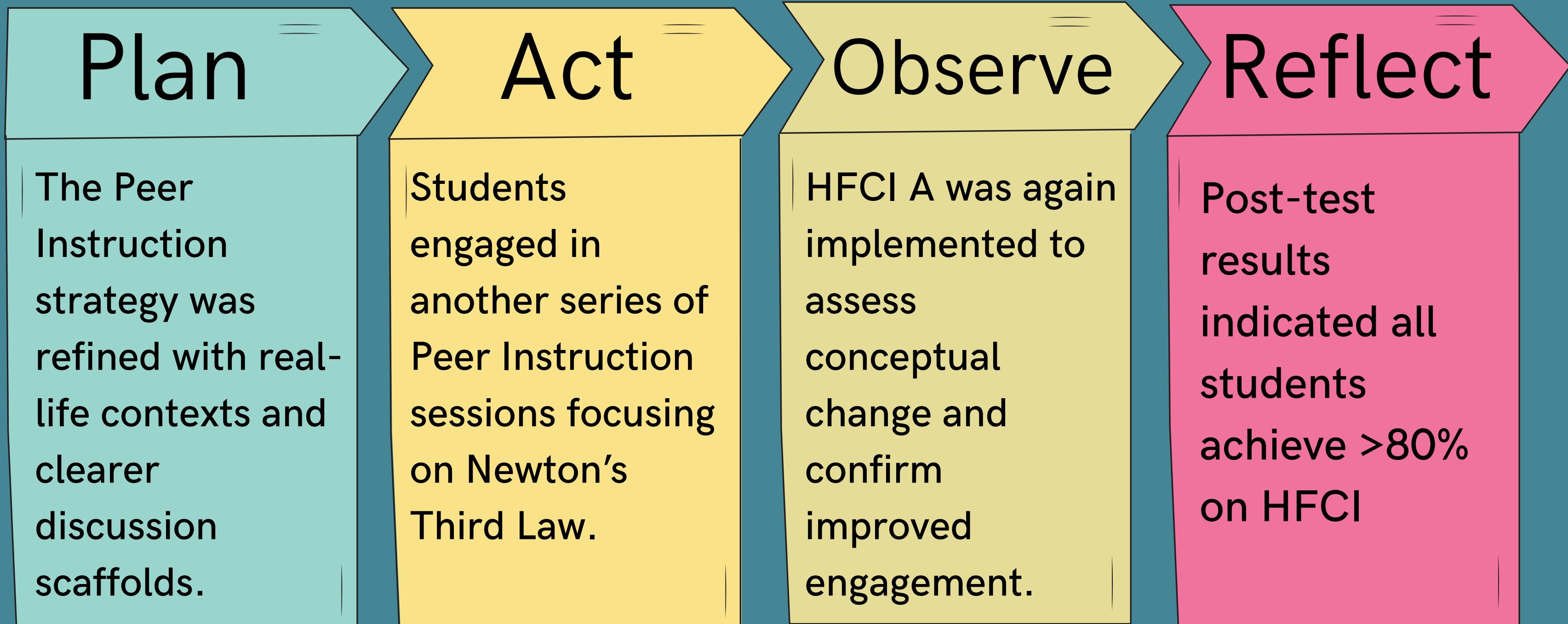


Kemmis and McTaggart

# Cycle 1 Reflection

The results from Cycle 1 showed that while students' conceptual understanding of force improved moderately, many still relied on memorized formulas rather than reasoning through concepts. Peer discussions helped expose misconceptions, but some concept questions were too abstract. Therefore, the next cycle will include more relatable, real-life examples and clearer discussion prompts to strengthen conceptual dialogue and reasoning.

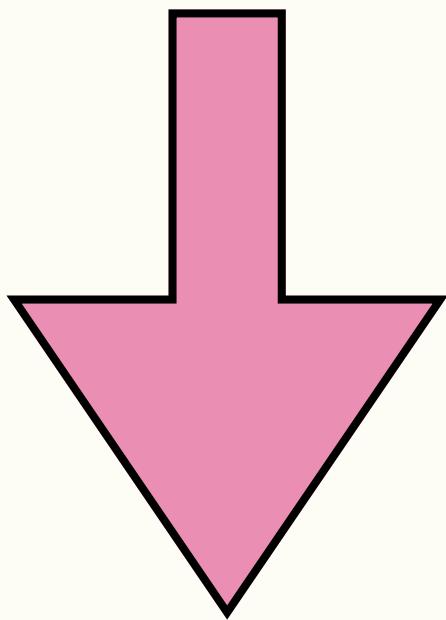
# Action Research Cycle 2



Kemmis and McTaggart

# Results!

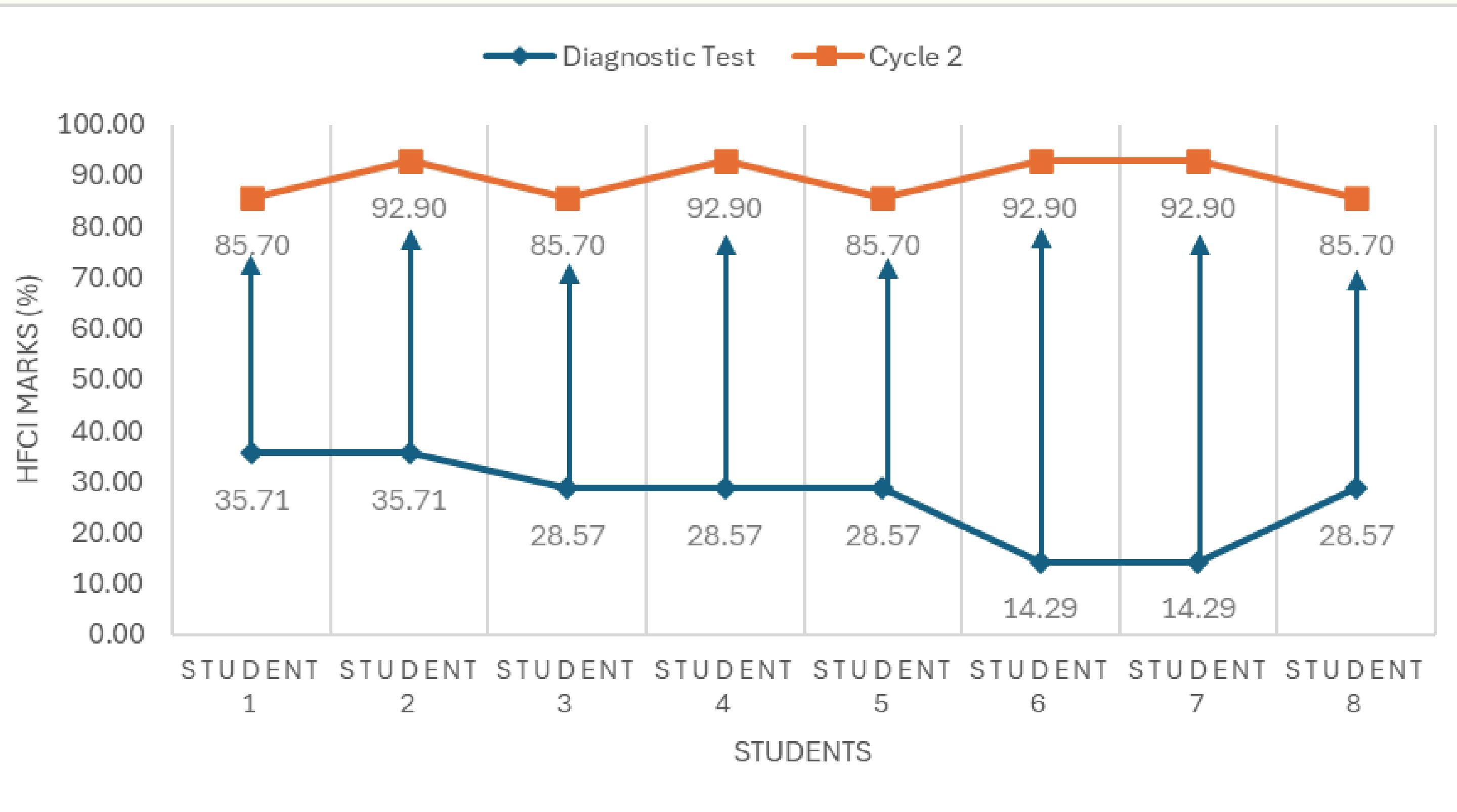
Diagnostic:  
26.8%



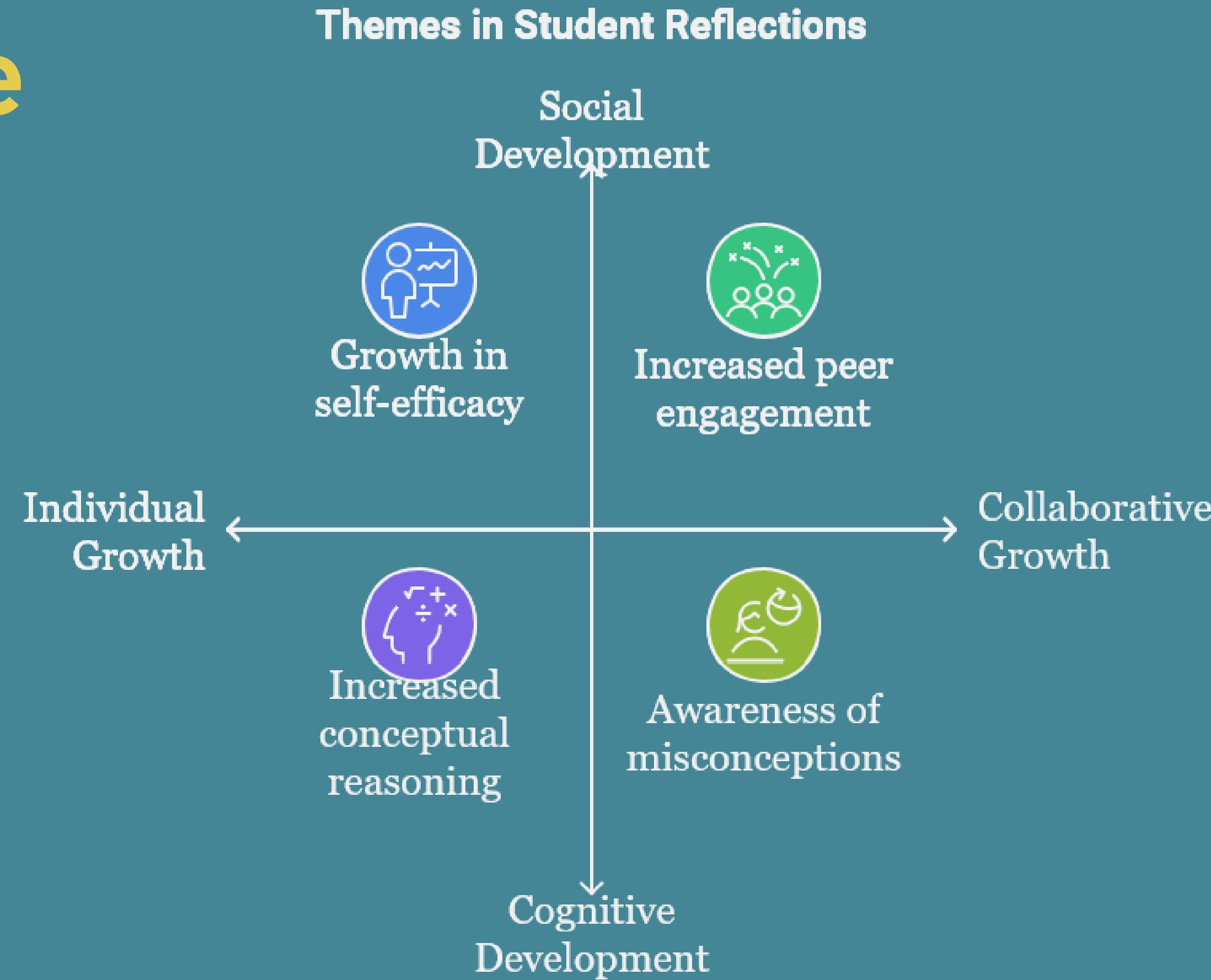
Cycle 1:  
56.3%



# Results!



# Qualitative Results!



# Reflections



**Peer Instruction effectively enhanced students' conceptual understanding and confidence in learning force concepts.**



**Clear evidence of conceptual gains, with all students achieving above 80% by the end of Cycle 2**



**Increased self-efficacy and enjoyment in collaborative learning**

## Adopt Active Learning Strategies

Incorporate Peer Instruction regularly in physics lessons to shift from teacher-centered to learner-centered approaches that promote active reasoning and conceptual understanding.

## Encourage Collaborative Dialogue

Foster structured peer discussion where students explain, defend, and revise their ideas, supporting learning through social interaction as proposed by Vygotsky (1978).

# Pedagogical Recommendations

## Integrate Formative Assessment

Use short conceptual quizzes, clicker responses, or mini HFCI items to provide ongoing feedback and identify misconceptions during lessons.

## Develop Students' Metacognition

Embed reflection activities after each Peer Instruction session so students can monitor their reasoning processes and recognize conceptual shifts.

# Key References



Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics*, 69(9), 970-977.

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-74.

Mazur, E. (1997). *Peer instruction: A user's manual*. Prentice Hall.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66(2), 211-227.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.



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