ICEE 2026 • FULL PAPER PRESENTATION

Critical and Creative Mathematical Thinking Skills and Self-Regulated Learning (SRL) in Elementary School Students

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Why mathematical thinking matters

Low higher-order thinking

AN and PISA data show Indonesian students score below the OECD average, mostly solving routine, rule-based problems.

Procedural, teacher-centred lessons

Algorithmic procedures and formula memorization limit students' mathematical reasoning on new problems.

Thinking + self-regulation

Critical and creative thinking work together with SRL to plan, control and check thinking (NCTM, 2020; Zimmerman, 2002).

Research objectives

1. Describe students' mathematical critical thinking skills
2. Describe students' mathematical creative thinking skills
3. Analyze students' self-regulated learning (SRL) in mathematics
4. Identify factors influencing critical thinking, creativity and SRL

METHOD

Qualitative descriptive case study

01

Design

Qualitative descriptive approach (Creswell & Poth, 2018)

02

Participants

25 fifth graders of a public elementary school, 2025/2026, purposive sampling

03

Data collection

Written tests, classroom observation, interviews, SRL questionnaire

04

Analysis

Miles & Huberman (1994) model with source and method triangulation

Research Instruments

Critical thinking test

Ennis (2011): interpretation, analysis, evaluation, inference, reflection

Creative thinking test

Torrance (1974): fluency, flexibility, originality, elaboration

SRL questionnaire

30 items – 3 dimensions: item validity 0.39 – Cronbach's $\alpha > 0.80$

Thinking Skills Remain Low

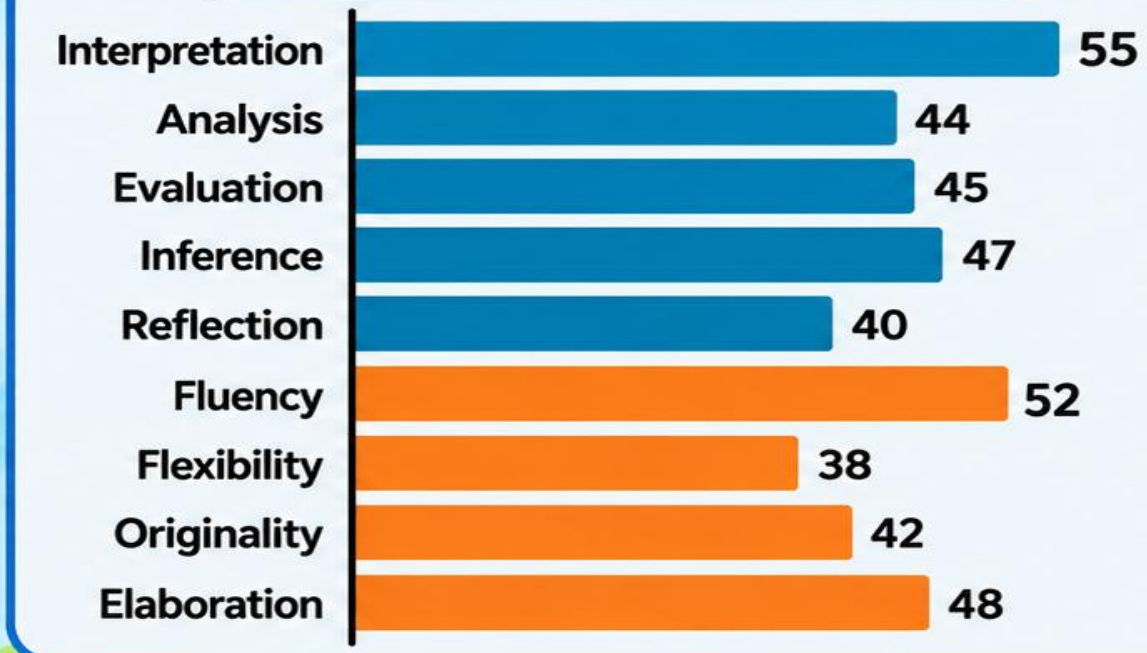
Students still need to improve their thinking skills!



49
Critical Thinking
mean score / 100
28% reach NMC (70)

46
Creative Thinking
mean score / 100
10% reach NMC (70)

Average Score per Indicator (%)



Choose the Right Answer (Flexibility)

A carton of paper is cut into a rectangle with a size of 10 cm².
What is the correct answer?

- ☐ 10 + 5
- ☐ Countup to 10 by 8
- ☐ 5 + 5
- ☐ 15 + 2

Student answer on the flexibility item: one pattern only



Conclusion

Students have high critical (49) and creative (46) thinking skills, but their **flexibility** and **originality** skills still need improvement.





Motivated Learners, Weak Self-Regulation

Students are enthusiastic, but still need to improve self-regulation skills!



86%
Learning Motivation
Students enjoy math and are happy solving problems.



80%
Plan Their Lessons
Students are able to plan their learning activities.



20%
Monitor & Reflect
Students remember to check and reflect on their own learning.

Questionnaire Results

No	Statement	1	2	3	4	5
1	I determine my own learning goals that are better than before.				✓	
2	I plan my learning activities so that I can understand the material.			✓		
3	I evaluate my own learning using quizzes or exercises.					✓
4	I reflect on my learning process before moving on.				✓	

Observation & Interviews:
Students can plan a learning strategy, choose the right method, and try to improve themselves.



Conclusion

Students have high learning motivation, but their self-regulation skills still need improvement.

Let's keep encouraging students to be more self-regulated!



What Holds Students Back

Key challenges that can hinder learning success

Procedural Learning



Drill and practice; teacher lectures, students imitate.

No Real-world Context



Computation without meaningful situations.

Little Reflection



Students rely on the teacher to judge solutions.

Answer-focused Culture



Wrong answers criticized, so students avoid risks.

Product-based Assessment



Results assessed, reasoning process ignored.

Learning Implications



- Contextual problems & problem posing
- Socratic questioning & reflection
- Psychological safety & assessment for learning

By addressing these challenges, we can help students become more independent, critical, and reflective learners!

From Procedural Drills to Reflective, Contextual Learning

Let's move beyond rote practice!

Low Thinking Skills

Critical **49** and creative **46**: weakest reflection (**40%**) and flexibility (**48%**).



High Motivation, Weak Regulation

86% motivated, but only **20%** plan and reflect systematically.



Way Forward

Context-rich, reflective, student-centred learning **(RME)** that builds students' control of their own thinking.



Thank you! | tatangherman@upi.edu