

Confronting Underachievement in Introductory Math Classes: Improving Learning for All Students through Metacognition and Self-Regulation

BACKGROUND

Mathematics is a gatekeeper class for many high school and first-year college students. Top-down fixes have improved pass rates with only partial success:

- Placement tests
- Remedial classes
- Student help centers
- Homework requirements
- Computer-based curriculum with immediate feedback
- Study skills classes and college success classes
- Reconfiguring of math curriculum
- Changes in pedagogy

One important thing is missing from these top-down approaches:

WHAT THE STUDENT BRINGS TO THE CLASSROOM

Students bring three things to classrooms that influence their success:

1. Background knowledge from previous coursework,
2. Intelligence or aptitude, and
3. The student-controlled ability to self-regulate their own learning

Student-controlled metacognition and self-regulation are positively associated with academic achievement according to Flavell (1978) and others.

Some researchers have attempted to increase this self-regulation and metacognition through direct instruction.

- ❖ This study tested a less direct method of increasing self-regulation in keeping with the idea that students construct their own knowledge within themselves.

METHODS

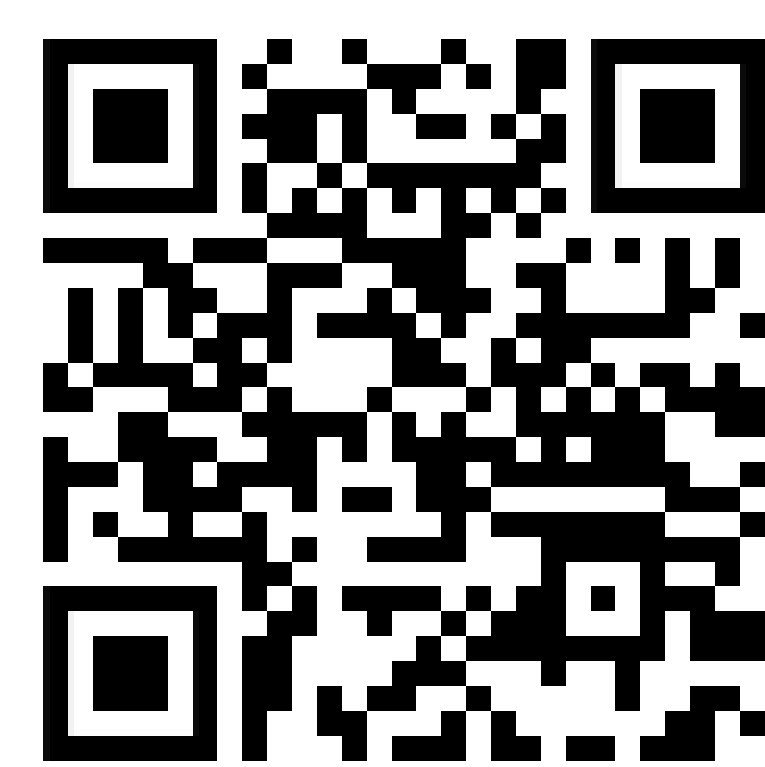
A quantitative post-test only control group experimental design research study. Random assignment of volunteers enrolled in Precalculus to experiment or control group. The experimental group took the Metacognitive Awareness Inventory (MAI) three times during a 9-week half-semester. In the inventory, students reflected on their learning practices and cognitions in relation to the learning in the Precalculus course.

MAI scores were compared across the three assessments. Grades of students in the MAI group were compared to grades of students in the control group.

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Multiple exposures to inventories of metacognitive ideas and practices improved awareness and use of these ideas and improved achievement in precalculus.

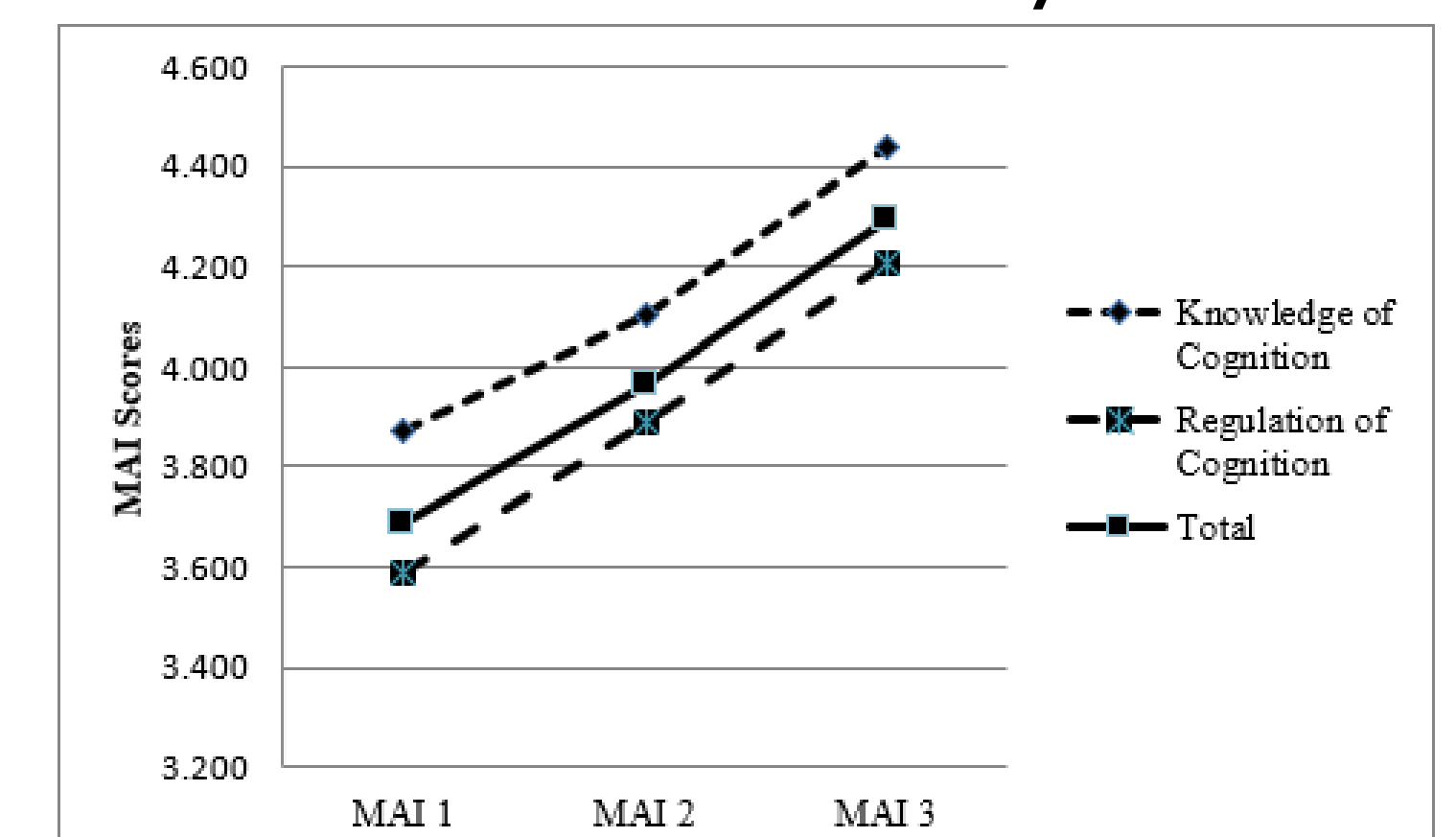


RESULTS

IMPROVED METACOGNITION

Exposure to self-regulating ideas resulted in significant increases across the three assessments on self-reported awareness and use of these behaviors ($p = .000$).

Mean Scores of Repeated Metacognitive Awareness Inventory

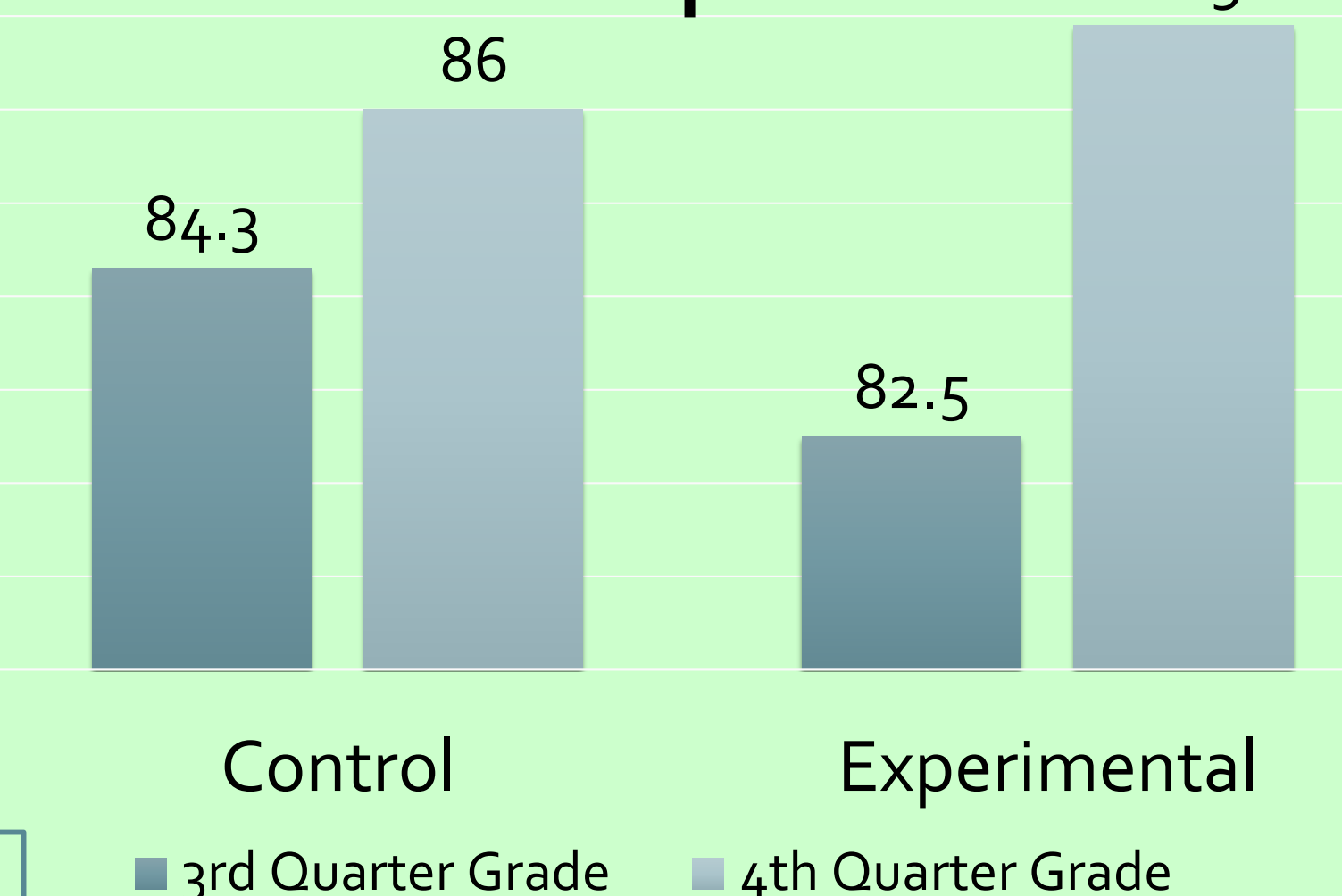


Note: The response presentation in the MAI survey consisted of a 5-point Likert scale (1 = "Not at all true for me" to 5 = "Always true for me").

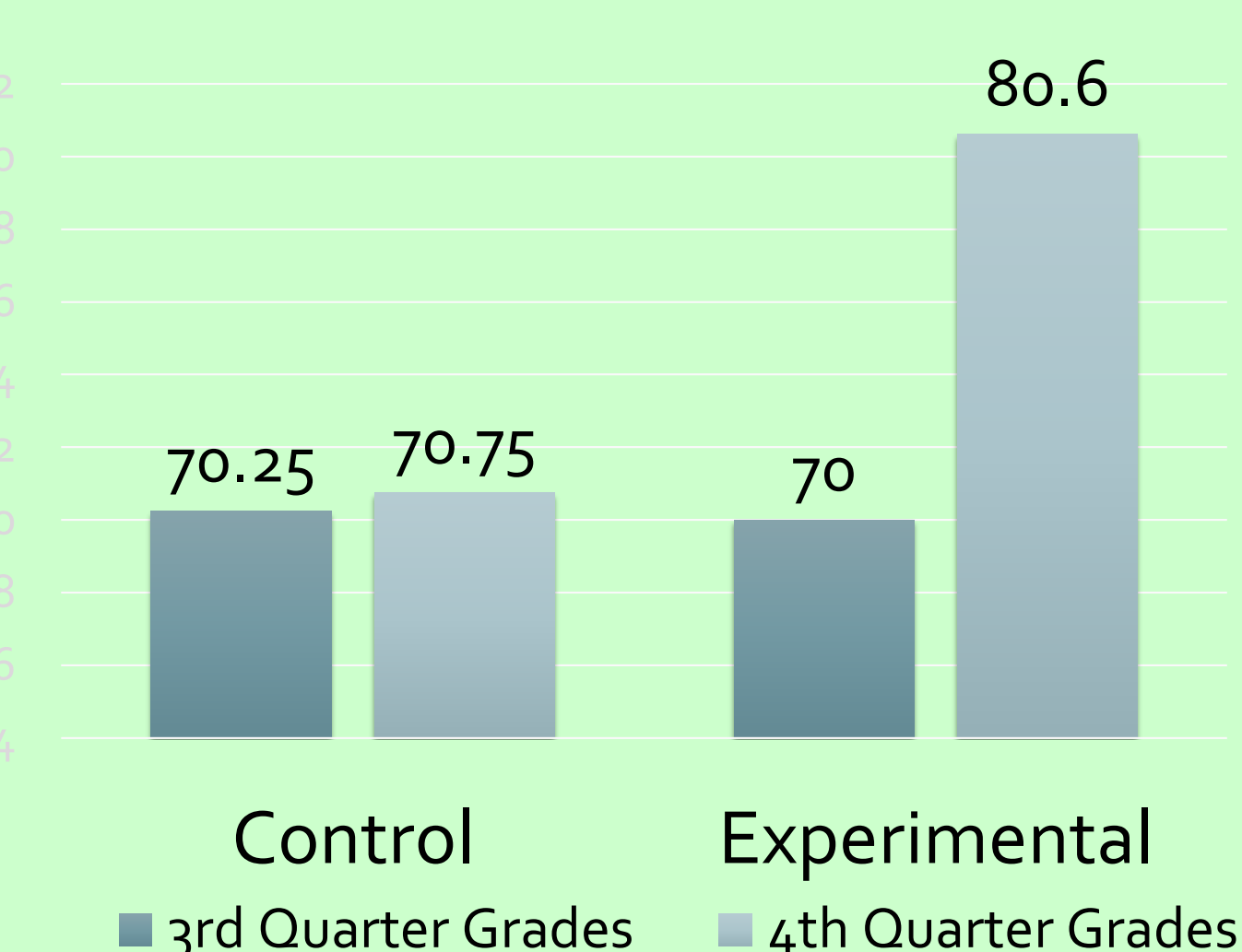
IMPROVED GRADES

Grade differences between 3rd and 4th quarter showed a significant increase for the experimental group ($n = 15$, $p = .028$), whereas the control group did not show significant increases ($n = 15$, $p = .150$).

Grade differences between Groups



Students with Ds and Fs



For those experimental group students who started with D's and F's, differences between 3rd and 4th quarter grades showed significant increases ($n = 5$; $p = .032$) for the 4th quarter compared to 3rd and 4th quarter grades of the control group ($n = 4$; $p = .424$).

IMPLICATIONS

1. Students became more active learners and recognized their responsibility for their own success, making them more mature, capable, confident, and successful as learners through increasing students' awareness of metacognition and self-regulatory behaviors.
2. The content-free nature of the surveys makes this process adaptable for use with any math curriculum at most any upper level high school or college level class.
3. Self-reflection and personalized feedback produced significantly improved self-regulation without direct instruction.
4. Improved learning practices appeared to be motivating, long-lasting, and transferrable to other learning situations.

