The Cure for Education:

Empowering Students to Assess and Remediate Their Own Knowledge

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The Problem

Recent reports from the National Assessment of Educational Progress (NAEP) show declining scores in reading and mathematics. Overall, NAEP finds that most U.S. students perform below grade level in core subjects.

Such reports are invariably followed by national outcries and calls for educational reform. Over the past few decades, numerous reforms have been implemented, including state and national educational standards, standardized state testing, new curriculum frameworks, and the integration of computers and the Internet into classrooms. Unfortunately, longitudinal analyses of assessment results show little improvement in student performance over time.

One major challenge in improving education is that, despite increasing student diversity—including variations in learning styles, speeds, and knowledge levels—our educational system remains rooted in a one-size-fits-all model. Students receive the same classroom instruction, textbooks, homework, and tests. This approach is understandable given the limitations in teacher availability and resources to serve millions of students. However, as long as solutions continue to follow this rigid model, the problem will persist.

Consider this common scenario: A student, while working on homework, encounters difficulty and thinks, “I’m stuck. I don’t get it.” What options does the student have? A teacher cannot individually assist every struggling student. Rereading the material might help, but test scores indicate that this is not an effective solution at scale. While some families can afford private tutors, most cannot, and there are simply not enough tutors for all students in need. Even government-funded tutoring programs serve only a fraction of the students who require support.

This scenario highlights why low student performance remains a persistent issue. It also underscores the reality that teachers, due to the large number of students they serve, cannot provide individualized remediation for each struggling learner. Therefore, an effective solution must empower students to take charge of their own learning—both inside and outside the classroom.

The Solution

This paper outlines an evidence-based approach to improving student achievement—one that is free, easy to implement, personalized to each student, and proven to significantly enhance performance. Our approach is based on a fundamental principle borrowed from the medical field: to find a cure, one must first diagnose the problem. In education, this means focusing on **self-assessment**.

Our method differs from the traditional approach, which primarily assesses student mastery based on the number of correct answers. This conventional model, rooted in **Classical Test Theory** (de Ayala, 2009), assumes that answering correctly demonstrates understanding. Accordingly, remediation often involves correcting mistakes—such as circling errors on a math test and showing the correct steps. However, this approach does not diagnose **why** the student made the mistake or ensure they won't repeat it in a different context.

We propose an assessment method that goes beyond surface-level performance and instead evaluates a student's conceptual understanding. For the past 40 years, we have researched and developed a technique called **Cognitive Structure Analysis (CSA)**.

CSA originated from research on expert knowledge—specifically, identifying what makes experts proficient in their fields (Leddo et al., 1990). This methodology assesses four distinct types of knowledge, which are well-documented in cognitive psychology literature:

- **Facts** (semantic knowledge) (Quillian, 1966)
- **Strategies** (problem-solving schemas) (Schank & Abelson, 1977)
- **Procedures** (steps involved in problem-solving) (Newell & Simon, 1972)
- **Rationales** (mental models explaining why concepts work) (de Kleer & Brown, 1981)

CSA uses structured queries to evaluate students' knowledge depth. The result is a comprehensive model of **what students know, at what level they understand it, and what gaps remain**. For example, most people recognize Einstein's equation, $E = mc^2$—this represents factual knowledge, the most basic level. Some may even be able to calculate E given m and c, demonstrating procedural knowledge. However, very few could explain the underlying principles or prove its validity—skills that require rationale knowledge, the deepest level of understanding.

Our research shows that CSA-based assessments can **accurately predict students' problem-solving performance** (Leddo et al., 2022; Ahmad & Leddo, 2023; Zhou & Leddo, 2023). More importantly, students who are **assessed and remediated using CSA** score **10**

points higher—equivalent to a full letter grade—compared to students who are assessed and remediated using traditional assessment methods (Leddo & Ahmad, 2024).

While transitioning to CSA-based assessments at a systemic level would improve student outcomes, it requires significant policy changes. A **more immediate and scalable solution** is to teach students to apply CSA **themselves**.

Self-Assessment: A Game-Changer for Student Learning

One of the biggest challenges in education is that students often **misjudge their own knowledge** (Leddo, Clark & Clark, 2021). CSA provides a structured method for **self-assessment**, helping students accurately identify what they understand and where they need improvement.

Our research confirms that students can learn to self-assess effectively in **just 10 minutes** (Cynkin & Leddo, 2023; Dandemraju, Dandemraju & Leddo, 2024). More importantly, students who self-assess and **relearn material with the goal of addressing their identified knowledge gaps** improve their performance by an average of **1.5 to 2.5 letter grades** compared to students who simply reread material without assessing their understanding. Additionally, students report that they **enjoy** the method because it gives them a clear roadmap for improvement.

We have published studies demonstrating the effectiveness of **self-assessment plus remediation** across multiple subjects, including math, reading, science, history, and foreign languages (Ravi & Leddo, 2024; Nehra & Leddo, 2024; Prakash & Leddo, 2025a,b, c).

Implementation: A Simple, Scalable Solution

Teaching students to self-assess is easy. They begin by reviewing an example of a self-assessment in a particular subject and then applying the same method to their own learning. Resources for self-assessment templates, instructions, and published studies are available **for free** at:
www.myedmaster.com/ways-to-improve-learning/

The simplest way to integrate self-assessment into schools is to **incorporate it into daily homework assignments**. Students should be required to submit a written self-assessment of their lesson, identifying their knowledge gaps, relearn the material to fill

those gaps and then write about the new knowledge they acquired after relearning the material.

Dr. John Leddo is committed to supporting any teacher, school, district, or state in implementing this program **for free**. His goal is to share his life's work to help students receive better educations and build brighter futures.

To learn more or collaborate on implementation, you can contact him at: **john@myedmaster.com**

Final Thoughts

Traditional approaches to education have remained largely unchanged despite growing student diversity and evolving learning needs. Cognitive Structure Analysis (CSA) offers a powerful, research-backed method to **help students take control of their own learning**. By incorporating **self-assessment plus remediation**, we can **dramatically improve student outcomes**—easily, for free, and at scale.

This approach has the potential to **transform education**—not by overburdening teachers, but by **empowering students** to recognize their own knowledge gaps and address them effectively.

It's time to shift the paradigm. The tools are available. The evidence is clear. The next step is action.

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