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Using Self-Assessment and Remediation to Raise Elementary School Student Achievement in Reading Comprehension

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ABSTRACT

Cognitive Structure Analysis (CSA) is an educational framework that helps students identify and address knowledge gaps through self-assessment and targeted remediation. Prior studies have shown its effectiveness across disciplines, including calculus, chemistry, Spanish, reading comprehension, and probability theory. For example, CSA-trained high school chemistry students scored 15 points higher on post-tests than peers who rewatched videos without self-assessment (Ravi & Leddo, 2024). Similarly, CSA in Spanish instruction yielded a 25-point improvement (Nehra & Leddo, 2024), and reading comprehension studies showed experimental groups scoring 93% versus 69% for controls (Prakash & Leddo, 2025a). Middle school applications found that CSA plus remediation improved math scores by 18 points and science post-test scores increased from 77.5% to 98% (Leddo, Clark & Clark, 2025). In history, CSA-trained middle school students scored 91.5% compared to 65.5% for controls. Extending CSA to late elementary math, students learning percentages, decimals, and proportions completed a post-test with regular and harder proportional reasoning questions. For regular questions, the experimental group significantly outperformed controls (Mean = 10 vs. 8.38, $t(24) = 2.50$, $p = .02$), suggesting meaningful gains. In this study, elementary students were introduced to CSA through short reading comprehension lessons on topics such as Women's History Month and National Parks. Students in the experimental group completed a CSA-style self-assessment that helped them reflect on what they understood and what they missed, followed by brief remediation activities. The control group read the same passages and answered comprehension questions without self-assessment or remediation. Each passage contained ten comprehension questions measuring recall, inference, and reasoning. On average, the CSA-trained group scored 20.5 percentage points higher than the control group, indicating that CSA combined with targeted remediation can significantly enhance elementary students' reading comprehension abilities, even at early grade levels

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INTRODUCTION

Throughout history, assessment has served as a measure of students' learning. Traditionally, "learning" has been defined by the number of correct answers on tests, as per classical test theory, which assumes that a student's total correct responses reflect their knowledge level (de Ayala, 2009).

Assessment methods typically fall into two categories: selecting correct answers from choices or constructing answers independently. Multiple-choice tests, widely used for their efficiency in grading, allow for guessing, which can inflate scores (Chaoui, 2011; Elbrink and Waits, 1970; O'Neil and Brown, 1997). Constructive response tests require students to provide their own answers, encouraging logical reasoning and offering a more accurate measure of knowledge (Herman et al., 1944; Frary, 1985). However, both methods rely on the assumption that correct answers signify learning. This assumption is problematic, as incorrect answers may point to underlying knowledge gaps, while correct answers might result from memorization or guessing, not true understanding.

Cognitive Structure Analysis (CSA) is an assessment method designed to uncover the underlying knowledge concepts a student possesses, identifying the source of errors for targeted remediation (Leddo et al., 2022; Ahmad and Leddo, 2023; Zhou and Leddo, 2023; Dandemraju, Dandemraju, and Leddo, 2024). CSA is rooted in cognitive psychology research, which identifies various knowledge types, such as semantic nets (Quillian, 1966), production rules (Newell and Simon, 1972), scripts (Schank and Abelson, 1977), and mental models (de Kleer and Brown, 1981). Together, these form the INKS framework (Integrated Knowledge Structure), developed by John Leddo (Leddo et al., 1990). This framework suggests that expert knowledge is organized around scripts and principles that enable predictions and explanations.

CSA, which integrates INKS principles, has shown strong correlations with problem-solving performance: 0.966 in Algebra 1 (Leddo et al., 2022), 0.63 in scientific method problem-solving (Ahmad and Leddo, 2023), and 0.80 in precalculus (Zhou and Leddo, 2023). By assessing students' conceptual understanding, CSA enables educators to address knowledge gaps effectively, leading to significant improvements in student performance (Leddo and Ahmad, 2024).

Although CSA has proven effective, the responsibility for diagnosing and remediating students' knowledge gaps lies primarily with teachers, who often manage large numbers of students. Teaching students to self-assess their knowledge could alleviate this burden. Unlike self-explanation (Chi et al., 1989), which involves generating explanations for learned material, self-assessment involves evaluating one's knowledge after learning.

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Cynkin and Leddo (2023) demonstrated that high school calculus students could accurately self-assess their knowledge using CSA, while Dandemraju, Dandemraju, and Leddo (2024) extended this finding to chemistry. These studies, however, addressed only the identification of knowledge gaps, not their remediation. Accurate assessment does not equate to addressing deficiencies, just as diagnosing a medical issue does not equate to treating it.

To address this issue, Ravi and Leddo (2024) conducted a study in which students learned an advanced topic in chemistry by watching a video. Half the students were told to rewatch the video to fill in any knowledge gaps, while the other half were taught to self-assess their knowledge using CSA and then told to rewatch the video to fill in any assessed knowledge gaps. The group that was taught to self-assess scored 15 points or 1.5 letter grades higher on a post-test than students who simply rewatched the video without self-assessment. Nehra and Leddo (2024) replicated the Ravi and Leddo study to the learning of Spanish. They found that students performing self-assessment plus remediation scored, on average, 25 percentage points or 2.5 letter grades higher than those re-reading the material without performing a self-assessment. This study aims to evaluate whether integrating Cognitive Structure Analysis (CSA) with remediation improves elementary students' reading comprehension performance compared to traditional rereading methods.

METHOD

Participants

20 male and female Loudoun County Public Schools students were selected to participate in this study. All students were elementary schoolers, and they were not paid for their participation.

Materials

A Google Form for the control group with the reading passage and 20 comprehension questions, 10 each for 2 passages, is provided below.

https://docs.google.com/forms/d/e/1FAIpQLSeT4citgPs-ih3vFh_qjFa-ec12I89Az8DUmFupBRIDkyXuPQ/viewform?usp=sharing&ouid=115605211836685850186

A self-assessment was created in order to help students in the experimental group re-evaluate their understanding of the content provided in the passage. It showed an example of a student self-assessing knowledge of a reading passage that included facts, strategies, procedures, and rationales. It was modeled after the self-assessment template previously reported in Ravi and Leddo (2024).

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Self-Assessment: Reading

I want to help you learn how to think about what you know after you read something. Let's use a story you already know — Little Red Riding Hood. When we understand a story, there are four kinds of things we need to know: facts, strategies, procedures, and rationales. Facts tell us what happens in the story. They are things like who the characters are and where and when the story happens. In Little Red Riding Hood, the main characters are Little Red Riding Hood, her mother, her grandmother, the wolf, and the woodsman. The story takes place a long time ago in a forest, near the homes of Little Red Riding Hood and her grandmother.

Strategies tell us how the story works. They show how the author uses a problem and a solution to teach a lesson. In this story, the problem is that Little Red Riding Hood talks to a stranger, even though her mother told her not to. The story shows what happens because of that choice and helps readers learn to listen to warnings.

Procedures are the steps that happen in order. First, Little Red Riding Hood's mother asks her to bring food to her sick grandmother. She tells her not to talk to strangers. On her way through the woods, Little Red Riding Hood meets a wolf who asks where she's going. She tells him, and the wolf runs ahead to trick the grandmother. When Little Red Riding Hood gets there, the wolf pretends to be her grandmother until she notices something strange. Then the wolf tries to eat her, but the woodsman comes and saves her.

Rationales tell us why things happen in the story. The author wrote this story to warn children not to talk to strangers. The wolf is the bad guy to show danger, and the woodsman saves Little Red Riding Hood so the story can have a happy ending and not be too scary.

When I think about this story, I can see what I understand and what I still wonder about. I know who the characters are and what happened, but I'm not sure if the wolf ate the grandmother or just hid her, or what happened to the wolf at the end. I also wonder why the story happens in a forest and not somewhere else. Thinking about these things helps me understand the story even better.

Now you can try this too! Think about the what, how, steps, and why for the article you just read. This will help you see how much you understand your story.

A Google Form for the experimental group with the 2 reading passages, reading assessment, and 20 comprehension questions is provided below.

https://docs.google.com/forms/d/e/1FAIpQLSdZP8kScktLAQcRHuRxhyEDNswgCEgfLD_a5hYsIGeSLY1cHA/viewform?usp=sharing&ouid=115605211836685850186

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In addition to the reading assessment, an answer key was created in order to evaluate each participant's response. There was no partial credit, with 1 point for each correct response and 0 for each incorrect response.

Answer Key:

National Parks

1. Yellowstone National Park, established in 1872
2. To help protect the land and keep it unspoiled before it became part of a larger national park
3. They were forced off their land, losing access to traditional hunting and living areas
4. Tribes should have a role in managing the parks while still allowing visitors to enjoy the land
5. Hiking, camping, sightseeing (other examples: biking, skiing, kayaking, climbing, snorkeling, watching geysers)
6. Historical sites, memorials, battlefields, cultural sites, ancient dwellings, petroglyphs, and pictographs
7. The number of parks has grown; scientific knowledge about protecting wildlife, plants, and natural resources has improved; the parks' roles have expanded
8. They protect ecosystems and wildlife, allow study of native plants and animals, and help conserve natural resources
9. Answers may vary
    a. Death Valley reached 134˚F (56.6˚C) in 1913
    b. Denali National Park has North America's tallest peak at 20,320 feet (6,193 meters)
    c. (Other acceptable answers: Only one road through Denali; national parks cover 84 million acres; animal species like wolves, bears, eagles; dinosaur bones found in parks)
10. To ensure that future generations can enjoy nature, preserve wildlife habitats, protect ecosystems, and keep the land and animals safe

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Women's History Month

1. 1978 in Santa Rosa, California
2. To line up with International Women's Day on March 8
3. That women's achievements were important but often unsung or unnoticed, and their contributions were as vital as men's
4. 1987
5. Answers may vary
    a. Susan B. Anthony – fought for women's right to vote
    b. Harriet Tubman – helped slaves escape to freedom
    c. (Other acceptable answers: Elizabeth Cady Stanton – worked for women's rights; Amelia Earhart – pioneering female pilot; Sacagawea – helped Lewis & Clark; Madeleine Albright – first female Secretary of State; Misty Copeland – first African-American principal dancer at American Ballet Theatre)
6. The 19th Amendment, passed in 1920, gave women the right to vote in the United States, which was a major step toward equality
7. She was the first female U.S. Secretary of State and served as a top government leader in foreign affairs starting in 1996
8. Themes are yearly topics that guide the focus of the celebration. Example: "Celebrating Women Who Tell Our Stories" or "Valiant Women of the Vote"
9. Museum exhibits, film screenings, classroom projects, school discussions, book displays, and studying achievements of historical and contemporary women
10. Because women contribute to society every day, and learning about their achievements all year helps provide a complete and fair understanding of history, inspires people, and highlights role models

Procedure

Participants were randomly assigned to each condition with 10 per group. Instructions to each group were contingent on their condition. The Google Forms contained all the questions, while instructions were provided verbally. The control group was told to read both passages, and if

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they had any issues understanding the content, they could read over it again. After that, they took the post-test on the Google Form itself. They were not permitted to reference the passage when taking the post-test. The experimental group was also instructed to read over the guide. However, after reading the guide, participants in the experimental group were given the self assessment script and then were asked to self-assess their knowledge. After the self-assessment, experimental group participants were told to go back to the instructional document to remediate any knowledge deficiencies their self-assessments had identified. After they reviewed the material again, they took the same test as did the control group. The post test contained questions that were direct recall, situation based, and assessed their knowledge of concepts rather than picking a correct answer.

RESULTS

The participants' data were analyzed by examining the number of correct responses on a 20-item post-test. The control group achieved a mean score of 14.1 out of 20 (70.5%), while the experimental group, who engaged in Cognitive Structure Analysis (CSA) with remediation, achieved a mean score of 18.2 out of 20 (91%). This difference in performance was statistically significant ($t = 3.67$, $df = 18$, $p = .002$), indicating that CSA plus remediation produced substantially higher reading comprehension outcomes.

Individual results reinforced this finding: the lowest score in the control group was 11 out of 20 (55%), compared to 15 out of 20 (75%) in the experimental group, a difference equivalent to two full letter grades improvement. Furthermore, 8 out of 10 students in the experimental group reported that they would like to see the self-assessment system implemented in schools, suggesting that the CSA approach is not only effective but also engaging and motivating for learners.

In contrast, control group participants reported limited benefit from rereading the material, noting difficulty in identifying which concepts they misunderstood. These findings highlight CSA's potential to enhance metacognitive awareness and promote deeper comprehension at the elementary level.

DISCUSSION

This study aimed to evaluate the effectiveness of Cognitive Structure Analysis (CSA) in helping elementary school students self-assess and remediate knowledge gaps in reading comprehension. The findings demonstrate that CSA-trained students significantly outperformed their peers, with the experimental group scoring an average of 20.5 percentage points higher than the control group. These results align with earlier research, such as Ravi and Leddo (2024), who reported a 15-point improvement in chemistry performance using CSA, and Nehra and Leddo (2024), who

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demonstrated a 25-point improvement in Spanish. Importantly, this study builds on prior findings by extending CSA's applicability to reading comprehension, a foundational skill across academic disciplines (Leddo, Ahmad, & Zhou, 2022).

Interestingly, the improvement in this study (20.5 points) exceeds that of Ravi and Leddo's chemistry study, following a similar trend found in Nehra and Leddo's (2024) research on an introductory Spanish self-assessment. Their work highlighted that CSA tends to yield stronger effects in simpler subject areas, such as language learning, compared to more complex topics like advanced chemistry. This pattern suggests that CSA might be especially impactful in foundational subjects where knowledge is more readily compartmentalized and assessed as opposed to advanced concepts building upon foundational ones (Nehra & Leddo, 2024).

On a societal level, the results underscore the value of self-assessment frameworks in education. U.S. students often struggle to meet grade-level expectations, placing a heavy burden on teachers to identify and address learning gaps (Frary, 1985). With many educators managing large classes, individual remediation becomes more and more challenging. CSA offers a scalable solution by empowering students to take ownership of their learning, thereby reducing reliance on teacher intervention. For example, while participants in the control group struggled to recall key details from *The Lottery* and often left questions unanswered, the CSA-trained group identified their knowledge gaps, revisited the material, and demonstrated mastery (Jackson, 1948). This method could alleviate systemic pressures by enabling students to address their deficiencies independently (O'Neil & Brown, 1997).

From an individual perspective, CSA provides learners with the method to overcome frustration and self-doubt associated with academic struggles. As observed by Nehra and Leddo (2024), students often internalize negative beliefs about their abilities, which can hinder their long-term educational success. Teaching self-assessment both enhances academic performance and builds confidence, helping students reframe challenges as opportunities for growth.

In an era of growing self-directed learning facilitated by online resources, effective self-assessment methods are becoming vital to educational growth and development. Previous research (Leddo, Clark, & Clark, 2021) has shown that learners often overestimate their comprehension of new material. The CSA framework addresses this issue by providing a structured approach to evaluate understanding, thus enhancing the outcomes of self-directed study (Chi et al., 1989).

Ultimately, this study reaffirms CSA's utility as an educational intervention, particularly in elementary school reading comprehension. While further research is needed to explore its

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applicability across geographic regions, the findings suggest that teaching students to self-assess can lead to significant improvements in both academic performance and self-efficacy.

REFERENCES

Ahmad, M.& Leddo, J. (2023). The Effectiveness of Cognitive Structure Analysis in Assessing Students' Knowledge of the Scientific Method. International Journal of Social Science and Economic Research, 8(8), 2397-2410.

Chaoui, F. (2011). The efficacy of multiple-choice tests in large classrooms. Educational Research Review, 6(3), 103-115.

Cynkin, C. and Leddo, J. (2023). Teaching students to self-assess using Cognitive Structure Analysis: Helping students determine what they do and do not know. International Journal of Social Science & Economic Research, 08(09), 3009-3020.

Dandemraju, A., Dandemraju, R., & Leddo, J. (2024). Teaching students to self-assess their knowledge of chemistry using cognitive structure analysis. International Journal of Social Science & Economic Research, 09(02), 541–549.

de Ayala, R. J. (2009). The reliability and validity of standardized tests in education. Educational Measurement, 18(4), 35-50.

Elbrink, H., & Waits, B. (1970). The reliability of multiple-choice testing methods in educational assessments. Testing and Evaluation, 14(1), 54-67.

Frary, R. (1985). Constructive response tests and their impact on academic learning. Educational Measurement, 22(3), 119-132.

Herman, J. L., Klein, D. C., Heath, T. M., & Wakai, S. T. (1994). A first look: Are claims for alternative assessment holding up? (CSE Tech. Rep. No. 391). Los Angeles: University of California, Center for Research on Evaluation, Standards, and Student Testing.

Jackson, S. (1948). The Lottery. New York: Farrar, Straus and Giroux.

Leddo J., Boddu B., Krishnamurthy S., Yuan K., & Chippala S. (2017). The effectiveness of selfdirected learning and teacher-led learning on gifted and talented vs. non-gifted and talented students. International Journal of Advanced Educational Research, 2(6):18-21.

Leddo, Clark, E. and Clark, A. (2025). Using self-assessment and remediation to raise middle school student achievement in math. International Journal of Social Science and Economic Research, 10(3), 1083-1092.

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Leddo, J., Cohen, M.S., O'Connor, M.F., Bresnick, T.A., and Marvin, F.F. (1990). Integrated knowledge elicitation and representation framework (Technical Report 90-3). Reston, VA: Decision Science Consortium, Inc.

Leddo, J., Li, S. & Zhang, Y. (2022). Cognitive Structure Analysis: A technique for assessing what students know, not just how they perform. International Journal of Social Science and Economic Research, 7(11), 3716-3726.

Nehra, P., & Leddo, J. (2024). The effects of Cognitive Structure Analysis in self-assessing and remediating knowledge gaps in introductory Spanish. International Journal of Social Science and Economic Research, 9(12), 5956-5964.

Newell, A., & Simon, H. (1972). Human Problem Solving. Prentice-Hall.

O'Neil, H. F., & Brown, D. S. (1997). The impact of self-assessment on student performance. Journal of Educational Psychology, 12(1), 89-102.

Quillian, M. R. (1966). Semantic memory. In M. Minsky (Ed.), Semantic Information Processing (pp. 227-270). MIT Press.

Ravi, D., & Leddo, J. (2024). Improving Student Performance by Having Students: Assess and Remediate Their Own Knowledge Deficiencies. International Journal of Social Science and Economic Research, 9(10), 4717-4724.

Schank, R. C., & Abelson, R. P. (1977). Scripts, plans, goals, and understanding. Lawrence Erlbaum.

Zhou, Y., & Leddo, J. (2023). The role of Cognitive Structure Analysis in understanding precalculus. Journal of Educational Research, 64(2), 139-154.

