Student Independent Self Assessment: Testing the Efficiency of Self Assessment in a Classroom Setting

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ABSTRACT

Earlier studies have introduced a method called Cognitive Structure Analysis (CSA), which evaluates a student's understanding of a subject beyond their ability to answer questions correctly. Findings showed that CSA-based assessments effectively predicted problem-solving performance. Cynkin and Leddo (2023) demonstrated that students could use CSA to self-assess their calculus knowledge, while Dandemraju and Leddo (2024) extended this to chemistry. Ravi and Leddo (2024) further explored how self-assessment could help students remediate their knowledge deficiencies. This study extends prior research by examining whether students can successfully remediate their knowledge gaps of a different subject area after self-assessment. The subject was introductory Spanish, focusing on basic greetings and verb conjugations. Fourteen high school students were taught these concepts using a beginner-friendly lesson plan. Half of the students were taught to use CSA for self-assessment and guided to review the material to address gaps, while the other half simply reviewed the lesson on their own. A post-test followed. The CSA-trained group scored an average of 5.99 out of 7 (85.61%), compared to 4.22 out of 7 (60.41%) for the non-CSA group. These results suggest students can effectively self-assess and address their own knowledge gaps. The implications for education on both individual and systemic levels are discussed.

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.

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. This study aims to extend the Ravi and Leddo (2024) findings to another subject area: beginning Spanish.

METHOD

Participants

14 male and female Oakton High School students were selected to participate in this study. All students had no prior experience with Spanish. However, they were all acquainted with different Romance languages. This difference provided a wider range of expertise on a potential topic covered in Spanish. None of the participants had knowledge regarding specific topics seen on the guide or test.

Materials

The educational content for greetings and conjugations was provided by a lesson plan. The link to the plan is shown below.

Introduction to Spanish: https://docs.google.com/document/d/18e4Igv8417BJCgJX6pY-NBrg-1OxjLzUi9o06GBZgZY/edit?usp=sharing

A self-assessment script was created below. It showed an example of a student self-assessing knowledge of a Spanish topic that included facts, strategies, procedures, and rationales. It was modeled after the self-assessment templated previously reported in Ravi and Leddo (2024).

Self-Assessment: Introducción a Español

Strategy

For greetings, I know that I need to use "Hola" (hello) to start a conversation and adjust my greeting depending on the time of day. In the morning, I say "Buenos días", in the afternoon "Buenas tardes", and at night "Buenas noches." I also know that I should be mindful of the gender of the noun I'm using for time of day, as "días" (morning) is masculine and "tardes" (afternoon) and "noches" (night) are feminine. I feel confident with these greetings, but I still get a little confused sometimes about when to use "Buenos" versus "Buenas" depending on whether the time of day is masculine or feminine.

I understand that the Spanish language contains cognates; this means that many of its words resemble those of English. It is not as if I am learning the language having no experiences with phonetics or morphemics.

For conjugating verbs, my strategy is to remember the endings for regular verbs that end in -ar, -er, and -ir. For example, I know that for -ar verbs like "hablar" (to speak), I use yo hablo (I speak), tú hablas (you speak), and él habla (he speaks). For -er verbs like "comer" (to eat), I use yo como (I eat) and tú comes (you eat). For -ir verbs like "vivir" (to live), I know the endings are yo vivo (I live) and tú vives (you live), but I get confused with the endings when using él/ella or nosotros.

To conjugate regular verbs, I follow these steps:

1. Identify the verb and remove the -ar, -er, or -ir ending.

2. Add the correct ending based on the subject pronoun.

For example, when conjugating "hablar", I remove -ar and add:

- yo hablo (I speak)

- tú hablas (you speak)

- él/ella habla (he/she speaks)

- nosotros hablamos (we speak)

- ellos hablan (they speak)

For -er and -ir verbs, the procedure is the same, but I need to pay extra attention to the different endings:
For comer (to eat):

- yo como (I eat)

- tú comes (you eat)

- él/ella come (he/she eats)

- nosotros comemos (we eat)

- ellos comen (they eat)

For vivir (to live):

- yo vivo (I live)

- tú vives (you live)

- él/ella vive (he/she lives)

- nosotros vivimos (we live)

- ellos viven (they live)

The rationale behind this process is that conjugating verbs correctly in Spanish depends on the subject pronoun. In English, we don't change each individual verb depending on the subject (I speak, you speak, he speaks), but in Spanish, each subject pronoun requires a different verb form. However, in English, we still do change the form. This is important for maintaining correct subject-verb agreement. Additionally, using the correct form of the greeting based on time of day and gender helps maintain formality and clarity in communication.

When I look over what I wrote, I realize I'm confident with the greetings (like "Buenos días" and "Buenas tardes") and the general process for conjugating -ar verbs, but I'm still a bit unsure about the gender rules for greetings. For -er and -ir verbs, I need more practice, especially with él/ella and nosotros forms, because I tend to mix up the endings.

I think I understand the strategy of how to form basic sentences in Spanish using regular verbs, and I know the procedures for conjugating. The rationale makes sense to me, but I need to focus on gender rules for greetings and more practice with -er and -ir verb conjugations.

I am confident in greeting people using the correct time of day and gendered forms, as well as conjugating -ar verbs correctly (like hablar).

I need more practice with the gender rules for time-of-day greetings and how to conjugate -er and -ir verbs, especially when dealing with él/ella and nosotros forms.

The post-test given to all Participants to display their knowledge is linked below.

https://docs.google.com/forms/d/1CdHIP_iLrcEPEtSqu2P8qN3f3kG0ciAN80NoHmhyqgc

Procedure

Participants were randomly assigned to each condition. 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 over the guide, and if 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. 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 the post-test. The results revealed a mean post-test score of 4.22 out of 7 (60.41%) for the control group and 5.99 out of 7 (85.61%) for the experimental group. This difference in averages was statistically significant ($t = 2.35$, df =12, $p < .04$). Notably, individual scores further illustrated the disparity: the highest score in the control group was 89.8%, meaning no student in that group achieved an A grade based on conventional grading standards.

Additionally, participants in the experimental group provided subjective feedback, describing the self-assessment method as useful and expressing interest in incorporating it into their study habits. This suggests that the approach is both effective and appealing for learners. In contrast, participants in the control group reported no benefits from rereading the guide, as they lacked structured tools to identify and address their knowledge gaps effectively.

DISCUSSION

This study aimed to determine whether students could effectively self-assess their Spanish knowledge and address gaps in understanding. The findings demonstrate that the participants were successful in self-assessing and improving their knowledge of the Spanish concepts introduced during the study. Self-assessment and remediation were shown to increase post-test scores by approximately 25 percentage points, equivalent to an improvement of about two and a half letter grades. These results highlight the potential for teaching students to self-assess and address their own learning needs, offering significant benefits both on an individual and societal level. These results are even stronger than our previous results of 15 percentage points improvement for an advanced chemistry topic (Ravi and Leddo, 2024). Collectively, these two results strengthen the hypothesis that students can learn to self-assess and improve their own performance. Interestingly, the effect was stronger for the simpler subject of elementary Spanish

than it was for advanced chemistry, raising the question that self-assessment is more effective for simpler topics than it is for more advanced topics.

At a societal level, U.S. students have historically struggled to perform at grade level in core academic areas. Traditionally, teachers bear the responsibility of identifying and addressing the needs of their students—a challenging task, especially for educators teaching over 100 students daily. This study suggests that encouraging students to self-assess and remediate their knowledge could substantially alleviate this burden on the educational system. Notably, in the control group, many students struggled to provide accurate conjugations, with some failing to answer entirely. In contrast, the experimental group demonstrated much greater success, with all but one participant achieving conjugation scores of at least 85% accuracy. While these findings may not be universally replicable, the lowest experimental group score was just 3 percentage points below the control group's average, emphasizing the method's effectiveness.

Additionally, the intervention required only a simple, one-page set of instructions, taking approximately 10 minutes to complete. Few other educational strategies are as cost-effective, scalable, and capable of yielding such immediate and substantial outcomes.

On an individual level, this approach also offers critical benefits. Many students experience frustration and self-doubt when they encounter topics they do not immediately understand. Such negative experiences can damage their self-esteem and diminish their enthusiasm for learning. Educators have observed countless students internalizing the belief that they are inherently poor learners or that certain subjects are beyond their grasp. Teaching self-assessment and remediation can empower these students, enabling them to take control of their learning and excel in subjects they might otherwise avoid.

Finally, in an era of growing self-directed learning opportunities, such as those provided by the Internet, the need for effective self-assessment tools has become increasingly important. Many learners engage with online content, such as instructional videos, and feel confident in their understanding without a clear way to measure their mastery. Previous research (e.g., Leddo, Clark, & Clark, 2021) has shown that both middle schoolers and adults often are poor judges of their own comprehension of newly learned material. The self-assessment framework used in this study addresses this challenge, offering learners a structured method to evaluate and improve their understanding, thus enhancing the effectiveness of self-directed learning efforts.

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