Discovering the Patterns across STEM Disciplines

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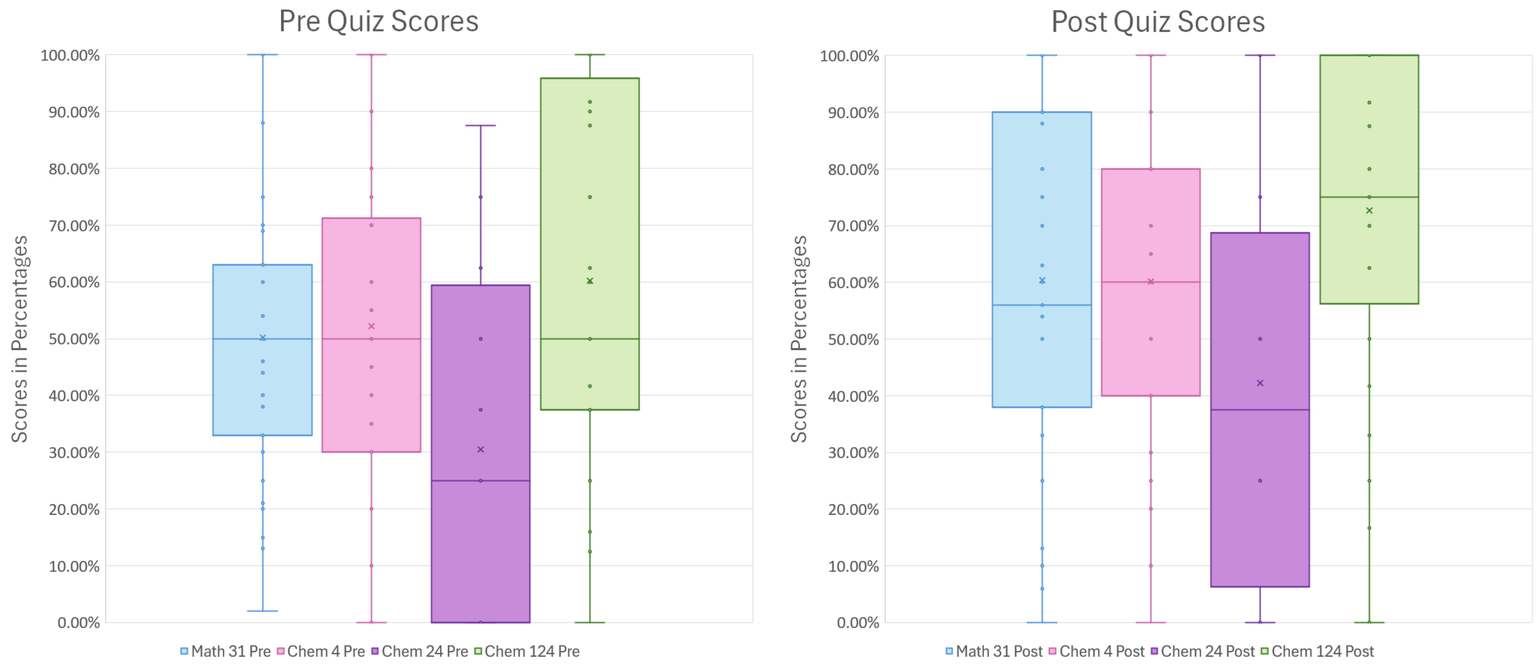
Abstract

Students encounter numerous obstacles throughout their college journey, with academic performance often standing out as a significant challenge. This study aimed to enhance the efficiency and accuracy of problem-solving skills among STEM students, with the intention of improving their overall academic performance. Each PAL class met twice a week and the experiment was conducted over weeks 5-12. The experimental design involved administering timed quizzes tailored to each subject at the beginning of class each week. On average, students' scores increased by 22% from the pre-quiz to the post-quiz. We concluded that when students can recognize patterns, they perform better on quizzes and exams.

Background

The study we have conducted aimed to improve students' overall understanding of course material through pattern recognition. In alignment with our research's aim, one study found that solving problems increased their ability to recognize patterns and apply them to related questions (Li et al., 2023). A different study also determined that when a "greater range of representations that can be connected to a single concept, the easier to retrieve the concept for use because those representations form a comprehensive network" (Wu, 2023). Furthermore, a study published by Jan Hessman emphasizes that patterns provide students with the right tool set to develop critical reasoning skills (2020). A related article also stated that "students learn to think logically and gain valuable problem-solving skills when learning to analyze patterns" (Wang, 2016).

Data & Results



Results: The analysis of the pre- and post-quiz data from our experiment yielded statistical significance. To interpret our data, we used the pair sampled t-test. For MATH 31, CHEM 4, and CHEM 124 the obtained p-values of 0.0192, 0.0138, and 0.0022 respectively, indicate a significant improvement in pattern recognition and problem-solving accuracy following the intervention.

Conversely, for CHEM 24, results yielded a p-value of 0.1844 that suggests no significant difference between pre- and post-quiz scores. CHEM 24 did experience a low sample size, however, which does play a role in the statistical analysis of the scores. These findings suggest that while our approach effectively enhanced pattern recognition and problem-solving skills in certain courses, its impact varied across subjects.

Methods

The experiment was conducted on students enrolled in a PAL course for MATH 31 (Calculus 2), CHEM 4 (Chemical Calculations), CHEM 24 and CHEM 124 (Organic Chemistry I, II). Each facilitator identified fundamental topics crucial for student comprehension and curated a worksheet of topics matching the lecture material being covered. A timed "pre-quiz" was administered at the beginning of the week followed by a brief discussion amongst the students to share what patterns they recognized. The following week the "post-quiz" was administered, using similar course material and patterns from the initial quiz. The study attempts to evaluate improvements in pattern recognition and accuracy of problem solving from the pre-quiz to the post-quiz.

Quotes

"Once I started going to PAL, my grade started to skyrocket, and [it is] definitely higher than the class average"

"I like how [PAL is run], because facilitators don't confirm or deny [answers]. This really encourages peers to work together"

Discussion

The hypothesis that pattern recognition enhances academic performance was mostly supported. The p-values suggested our results were statistically significant, with the exception of CHEM 24 due to the low sample size. We reasoned that students could recognize patterns more efficiently and complete the quizzes faster and with a higher accuracy during the post-quiz. Possible errors could result from students who did not attempt the quiz with the necessary effort and diligence. Future studies could examine how individual differences such as previous knowledge of the material, study habits, learning styles, etc., influence the effectiveness of pattern recognition. Furthermore, our study contributes to the broader discourse on cognitive processes in education, shedding light on the mechanisms underlying effective learning strategies.

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