



# Enhancing Students' Conceptual Retention in Science Through the Integration of Dual Coding and Elaborative Interrogation Prompts

Maica Joy M. Eleccion<sup>1</sup>, Jocelle May V. Dinulos<sup>2</sup>, Genelyn R. Baluyos<sup>3</sup>

<sup>1,3</sup>College of Education, Misamis University

<sup>2</sup>Ozamiz City National High School

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## ABSTRACT

As science education continues to seek effective approaches to improve students' learning, instructional strategies such as Dual Coding and Elaborative Interrogation Prompts (EIP) have become valuable in enhancing conceptual retention and understanding. This action research determined the effectiveness of integrating Dual Coding and Elaborative Interrogation Prompts (EIP) in improving Grade 8 students' conceptual retention in Science. The study was conducted in one of the public secondary schools in Ozamiz City during the School Year 2025–2026. A one-group pretest-posttest research design was employed using a 50-item researcher-made test to measure students' conceptual retention before and after the implementation of the intervention. Data were analyzed using frequency, percentage, mean, standard deviation, and paired t-test through Jamovi software. Findings revealed that before the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP), students demonstrated low conceptual retention in Science, with most of them falling under the Did Not Meet Expectations category. After the intervention, students' performance improved significantly, reaching a Satisfactory level. Statistical analysis showed a highly significant difference between the pretest and posttest results ( $t = 8.50$ ,  $p < .001$ ), indicating that the intervention effectively enhanced students' conceptual retention and understanding of scientific concepts. The study concludes that integrating Dual Coding and Elaborative Interrogation Prompts (EIP) strengthens students' comprehension, retention, and academic performance in Science. Therefore, the use of these learner-centered and evidence-based instructional strategies is recommended in Science instruction. Future researchers are encouraged to replicate the study using larger samples, longer intervention periods, and other subject areas to further validate the effectiveness of the intervention.

**Keywords:** conceptual retention, Dual Coding, Elaborative Interrogation Prompts, Science education, students' performance

## INTRODUCTION

In science education, developing students' long-term conceptual understanding remains a key goal of effective instruction. Conceptual retention refers to learners' ability to store and retrieve scientific knowledge over time, which is often influenced by the learning strategies teachers employ. Prior studies in cognitive science show that dual coding improves memory because it requires deeper mental processing than simply reading or writing, making it a form of desirable difficulty (Gorman, 2022). In addition, the Elaborative Interrogation Prompts (EIP) learning strategies such as summarizing, self-explanation, and creating mind maps have been reported as more effective than other techniques in helping students understand and retain information (Sambeth, 2022). The integration of Dual Coding and Elaborative Interrogation Prompts (EIP) represents a promising instructional innovation designed to strengthen retention and comprehension. These approaches address cognitive load, foster self-regulated learning, and improve conceptual retention by encouraging active engagement with scientific material (Nebel & Sumeracki, 2025; Mir et al., 2023).

Despite the growing interest in effective learning strategies, research has revealed that empirically supported techniques such as dual coding and elaborative interrogation remain underutilized in classrooms (Surma et al., 2022). Studies show that both students and novice teachers frequently depend on ineffective strategies like rereading and highlighting, which contribute little to long-term understanding (Seban et al., 2024). This limitation emphasizes the need for explicit integration of evidence-based strategies that promote meaningful learning (Carpenter et al., 2022). Furthermore, while dual coding supports the visualization of abstract concepts, it may not equally cater to all learning preferences, and elaborative interrogation can be time-consuming if not properly scaffolded (Mir et al., 2023).

The challenge of poor conceptual retention among students has been documented across various educational levels (Tise, 2021). Studies indicate that many learners struggle to recall scientific concepts after instruction due to passive learning approaches and limited cognitive engagement (Seban & Urban, 2024). Science teachers often prioritize content delivery over strategies and training, which restricts students' ability to independently regulate their learning (Gorman, 2022). As a result, despite exposure to scientific information, students frequently exhibit surface-level understanding and fail to transfer knowledge to new contexts. This issue highlights the importance of combining visual aids and reasoning prompts to improve the depth and durability of learning outcomes in science classrooms.

Supporting evidence shows that the dual coding strategy enhances recall by activating both the verbal and visual systems of memory, effectively reducing cognitive overload and facilitating knowledge integration (Lee & Lee, 2022). Similarly, elaborative interrogation prompts foster metacognitive engagement, allowing learners to link new information to prior knowledge and improve inferential thinking (Farooq & Maher, 2021). These techniques align with the broader cognitive theory of multimedia learning, which suggests that using multiple representational modes leads to deeper conceptual processing (Nebel & Sumeracki, 2025). Empirical studies in different contexts have validated the effectiveness of these strategies in improving scientific literacy, retention, and comprehension (Moreno et al., 2021).

Nevertheless, a research gap in practical knowledge seems evident in previous research and persists in the localized and combined use of dual coding and elaborative interrogation prompts in secondary science education (Fox, 2024). Most existing studies have independently explored either visual or elaborative techniques; however, there is a limited number of practical studies or action research projects that examine their integration as a unified instructional intervention (Miles, 2017). Addressing this gap can provide context-based insights into how these strategies enhance students' comprehension and retention in science

This study determined the effectiveness of integrating Dual Coding and Elaborative Interrogation Prompts (EIP) in enhancing students' conceptual retention and understanding of scientific concepts in science education. Specifically, it explored how the combined use of visual and verbal representations with reasoning-based questioning improved students' long-term memory, comprehension, and engagement in learning science. The findings provided educators, curriculum developers, and future researchers with data-driven insights into strategies that enhanced students' long-term conceptual understanding. Moreover, the scope of the study targeted Grade 8 students at the secondary level in one of the public schools in the city to examine how these strategies effectively improved the retention of key scientific concepts in early secondary education. In doing so, this research supported the advancement of innovative, learner-centered pedagogies that promoted critical thinking, deep learning, and sustained academic performance in science education.

## Strategy

Evidence-based teaching techniques like Dual Coding and Elaborative Interrogation Prompts (EIP) improve students' capacity to comprehend, arrange, and remember scientific material. Dual Coding, derived from cognitive psychology, emphasizes combining verbal and visual representations to enhance memory formation and recall (Dogomeo & Aliazas, 2022). This learning strategy, rooted in cognitive science, stresses the integration of spoken explanations and visual representations, allowing students to develop deeper conceptual understanding and more complex mental models (Clark & Paivio, 2021).



Elaborative Interrogation involves prompting learners to generate explanations to “why” and “how” questions, thereby promoting deeper processing and meaningful learning connections (Killian et al., 2024). By asking students to explain “why” a fact or concept is true, elaborative questioning facilitates meaningful learning by connecting new material with existing knowledge and real-world settings (Rittle-Johnson et al., 2022). When combined, these techniques foster critical thinking, long-term retention, and active engagement skills crucial for 21st-century science learners.

The intervention will be implemented for one to two months in the Science curriculum using Dual Coding and Elaborative Interrogation Prompts, beginning each lesson with the researcher introducing key scientific concepts through visual and verbal representations such as diagrams, flowcharts, illustrations, and concept maps to support students' initial understanding. Students interpret these visuals, describe their observations, and connect them to the lesson's main ideas.

The researcher applies elaborative interrogation by asking reasoning-based questions that prompt students to explain why concepts work, how processes occur, or why certain features are important, guiding them to link new knowledge with prior learning. Students work individually or in groups to answer the prompts, discuss insights, and refine their explanations through collaboration. In lesson activities, students analyze visuals and respond to “why” and “how” questions, share their interpretations, and adjust their understanding based on peer and researcher feedback. Throughout the sessions, students create their own diagrams, summarize concepts visually, and respond to analytical prompts, strengthening their reasoning, comprehension, and long-term retention of scientific concepts.

### Statement of the Problem

1. This action research aimed to enhance Grade 8 students' performance in Science through Dual Coding and Elaborative Interrogation Prompts (EIP) strategies.
2. Specifically, this study sought to answer the following research questions:
3. What is the performance of students in conceptual retention in Science before the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)?
4. What is the performance of students in conceptual retention in Science after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)?
5. Is there a significant difference in students' performance in conceptual retention in Science before and after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)?

### Null Hypotheses

H<sub>01</sub>: There is no significant difference in the level of conceptual retention of students in science before and after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP).

## METHODS

### Research Design

This study employed a classroom-based action research approach using a single pretest–posttest design. A single pretest–posttest design evaluated an intervention by measuring participants' outcomes before and after its implementation without the use of a control group (Marcos et al., 2024). This design was well-suited to the study, as it allowed measurable assessment of learning gains resulting from the application of cognitive-based instructional strategies. The test approach provided clear quantitative data to evaluate changes in students' retention and comprehension of scientific concepts (Llido et al., 2025).

### Research Setting

The study was conducted in one of the junior high schools located in Ozamiz City, within the province of Misamis Occidental. It involved Grade 8 students from a selected class section. The institution was a complete secondary school that offered education from Grades 7 to 12. It implemented various academic programs,



including the Regular Curriculum, Special Science Curriculum, Special Program for the Arts, Strengthened Technical-Vocational Education Program (STVEP), and the Open High School Program.

The school was dedicated to delivering curriculum-based, high-quality, and affordable education to the local community. It fostered a diverse and inclusive learning environment that accommodated students with different backgrounds, interests, and abilities. This made it an ideal setting for implementing the Dual Coding and Elaborative Interrogation Prompts (EIP) strategies, which aimed to enhance students' conceptual understanding and retention in Science.

### Respondents of the Study

The study involved forty (40) Grade 8 students. Participants were chosen using purposive sampling, based on the following criteria: (1) students enrolled as Grade 8 learners in a specific secondary institution in Ozamiz City for the academic year 2025–2026; (2) students were observed to need support in science learning; and (3) students who provided voluntary consent to participate in the study. Before administering the survey, the researcher ensured that all criteria were met.

### Research Instruments

To gather data, the researcher used the following research instruments:

A. Test (Appendix A). The instrument was a 50-item test covering the intended topics of Science 8 from the fourth grading period. The same set of questions was used for both tests; however, in the posttest, the items were rearranged to prevent memorization. The first test measured the students' baseline knowledge of Science concepts, while the last test evaluated the effectiveness of the Dual Coding and Elaborative Interrogation Prompts (EIP) learning strategies in improving their academic performance in Science.

The test underwent expert evaluation by the research adviser, cooperating teacher, school head, and principal to verify its content validity. The evaluation focused on content, alignment with the curriculum, clarity of questions, and appropriateness for the target grade level. Moreover, a pilot test was carried out on a separate group of students from other sections. The instrument's reliability was then analyzed using Cronbach's Alpha, and the researcher ensured that it achieved a score between 0.7 and 1.0, indicating acceptable to excellent internal consistency.

In determining the test performance, the following scale was used.

| Score   | Grade Equivalent | Interpretation    |
|---------|------------------|-------------------|
| 42 – 50 | 90-100           | Outstanding       |
| 38 – 41 | 85-89            | Very Satisfactory |
| 34 – 37 | 80-84            | Satisfactory      |



|         |          |                           |
|---------|----------|---------------------------|
| 30 – 33 | 75-79    | Fairly Satisfactory       |
| 1 – 29  | Below 75 | Did not meet expectations |

Lesson Plan (Appendix B). The researcher developed a series of lesson plans focused on various Physics topics, as guided by the cooperating teacher. These lesson plans incorporated Dual Coding and Elaborative Interrogation Prompts (EIP) to enhance students' understanding and performance in Science. Before implementation, the cooperating teacher carefully reviewed the lesson plans, and the researcher made necessary revisions to ensure alignment with the prescribed curriculum and the attainment of the intended learning objectives.

### Data Collection

This action research gathered quantitative results. Grade 8 students' science performance was measured using a researcher-made instrument, such as test questions.

**Pre-Implementation Phase.** During this phase, the researcher observed emerging challenges that students experienced in their science learning. Insights and information about these challenges were obtained through extensive observations. The researcher began writing the research proposal, created lesson plans, prepared the pre-test and post-test, and developed prototype strategies. The researcher then requested permission from the Superintendent of the Division of Ozamiz City, as well as consent from the principal and cooperating teacher, to conduct the study in a secondary school in Ozamiz City.

**Implementation Phase.** The implementation stage included collecting data, which involved administering the pre-test to the participants, implementing the targeted learning strategies for a specific period, and monitoring the participants' performance and attitude. After the intervention, the researcher conducted the post-test assessment. This phase also included retrieving, tallying, analyzing, and interpreting the data to determine whether the strategies were significantly effective.

**Post-Implementation Phase.** The post-implementation phase involved drawing conclusions, making recommendations, proofreading, revising, and completing the research project. It also included properly communicating the research findings to the intended audience.

### Ethical Considerations

Ethics in research referred to the standards and principles that guided choices about data collection, analysis, and distribution (Gedutis et al., 2022).

Prior to conducting the research, the researcher requested consent from the Misamis University Research Ethics Committee (MUREC) to ensure compliance with institutional and ethical research standards and to ensure that the study met the institution's ethical standards. In addition, the researcher sought approval from the Superintendent of the Division of Ozamiz City, as well as consent from the principal and cooperating teacher, to conduct the study in one of the junior high schools in Ozamiz City.

After receiving the approved letter, the researcher secured informed consent from the participants. The participants were informed of the study's aims, data confidentiality, potential advantages, and other relevant details, as well as their anonymity throughout the process. Furthermore, the researcher reminded the participants that their participation was entirely voluntary and that they could choose to respond or decline if they felt uncomfortable. In order to preserve the confidentiality and dignity of the participants and their

organization, the researcher strictly followed Republic Act No. 10173, also known as the “Data Privacy Act of 2012,” along with the ethical guidelines when collecting, analyzing, and disseminating the study’s findings.

## Data Analysis

The study utilized the following tools for analyzing the collected data using Jamovi software:

*Mean and Standard Deviation* were used to determine the students’ average performance and the consistency of their scores before and after the integration of Dual Coding and Elaborative Interrogation Prompts (EIP).

*Frequency and Percentage* were used to identify the level of students’ performance before and after the integration of Dual Coding and Elaborative Interrogation Prompts (EIP).

*Paired T-test* was used to examine whether there was a statistically significant difference in student performance before and after the integration of Dual Coding and Elaborative Interrogation Prompts (EIP).

## RESULTS AND DISCUSSION

### Students’ Performance in Conceptual Retention in Science Before the Implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)

Table 1 presented the students’ performance in conceptual retention in science before the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP). The overall level of conceptual retention in science was relatively low, with an overall mean score of ( $M = 29.9$ ,  $SD = 4.49$ ), which fell under the Did Not Meet Expectations category. This means that students’ learning was limited and traditional instructional approaches alone were not sufficient to support strong conceptual understanding in science.

It further implies the need for more effective instructional strategies that actively engage students in meaningful learning and deeper cognitive processing. Moreover, the findings highlight gaps in students’ ability to retain and apply scientific concepts, suggesting that enhanced teaching approaches such as Dual Coding and Elaborative Interrogation Prompts may be necessary to improve their learning outcomes.

Among the performance levels, the highest mean score was observed among students classified as Outstanding ( $n = 1$ , 2.5%,  $M = 35.5$ ,  $SD = 5.916$ ), followed by those in the Very Satisfactory category ( $n = 2$ , 5.0%,  $M = 31.0$ ,  $SD = 3.684$ ). Students under the Satisfactory level obtained a mean score of ( $n = 5$ , 12.5%,  $M = 28.0$ ,  $SD = 4.320$ ), while those categorized as Fairly Satisfactory had a mean of ( $n = 12$ , 30.0%,  $M = 27.4$ ,  $SD = 2.966$ ). The lowest and largest group of respondents belonged to the Did Not Meet Expectations category ( $n = 20$ , 50.0%,  $M = 29.7$ ,  $SD = 2.082$ ).

These findings indicate that a considerable proportion of students showed limited conceptual retention in science before the instructional intervention. Recent studies support the use of Dual Coding and elaborative learning strategies in science education. For example, dual coding through infographics has been shown to enhance students’ scientific understanding (Dogomeo & Aliazas, 2022), while also improving retention of science concepts among learners (Mir et al., 2023). In addition, elaborative interrogation promotes deeper learning by encouraging students to explain relationships among concepts (Moreno et al., 2021).

Similarly, elaboration strategies strengthen meaningful learning and long-term memory retention (Van Hoof et al., 2022). Overall, these studies suggest that integrating Dual Coding and Elaborative Interrogation Prompts is an effective and evidence-based approach to address gaps in science conceptual retention.

The findings suggested that many students experienced difficulty retaining and understanding scientific concepts before the integration of Dual Coding and Elaborative Interrogation Prompts. The dominance of students within the Did Not Meet Expectations category implied that traditional instructional approaches may not have sufficiently supported deep conceptual processing and long-term retention. Science concepts often



involve abstract and complex information, which may become difficult for learners to recall when instruction relies heavily on verbal explanation alone.

The relatively low performance levels also reflected possible gaps in students' ability to connect prior knowledge with newly learned concepts. Furthermore, the limited number of students who reached the Outstanding and Very Satisfactory levels indicated that only a few learners were able to independently develop effective retention and comprehension strategies. These results highlighted the need for more engaging and cognitively supportive teaching approaches that encourage active processing, visualization, and meaningful explanation of scientific ideas.

**Table 1**

**Students' Performance in Conceptual Retention in Science Before the Implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)**

| Performance               | Frequency | Percentage | M    | SD    |
|---------------------------|-----------|------------|------|-------|
| Outstanding               | 1         | 2.5        | 35.5 | 5.916 |
| Very Satisfactory         | 2         | 5.0        | 31.0 | 3.684 |
| Satisfactory              | 5         | 12.5       | 28.0 | 4.320 |
| Fairly Satisfactory       | 12        | 30.0       | 27.4 | 2.966 |
| Did not meet expectations | 20        | 50.0       | 29.7 | 2.082 |
| Overall Performance       | 40        | 100.00     | 29.9 | 4.49  |

Note: 42–50 (Outstanding); 38–41 (Very Satisfactory); 34–37 (Satisfactory); 30–33 (Fairly Satisfactory); 1–29 (Did Not Meet Expectations)

**Students' Performance in Conceptual Retention in Science After the Implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)**

Table 2 presented the students' performance in conceptual retention in science after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP). The overall performance of the students showed improvement, with an overall mean score of ( $M = 36.7$ ,  $SD = 4.44$ ), which fell under the Satisfactory category. This indicates that students were able to better retain and understand science concepts after the intervention. The improvement suggests that the use of Dual Coding and EIP helped enhance students' learning by making information more meaningful and easier to process, leading to better conceptual understanding in science.

Among the performance levels, students in the Outstanding category obtained the highest mean score ( $n = 4$ , 10.0%,  $M = 43.3$ ,  $SD = 1.258$ ), followed by those classified as Very Satisfactory ( $n = 15$ , 37.5%,  $M = 39.5$ ,  $SD = 1.125$ ). Students under the Satisfactory category recorded a mean score of ( $n = 13$ , 32.5%,  $M = 35.6$ ,  $SD = 1.193$ ), while those in the Fairly Satisfactory level obtained ( $n = 5$ , 12.5%,  $M = 31.4$ ,  $SD = 0.894$ ). The lowest performance was observed among students who Did Not Meet Expectations ( $n = 3$ , 7.5%,  $M = 27.3$ ,  $SD = 2.887$ ).



These findings indicate that most students achieved Satisfactory to Very Satisfactory levels of conceptual retention after the instructional intervention. This improvement is supported by previous studies showing that multimodal and elaborative instructional strategies enhance learning in science.

For instance, self-explanation prompts have been found to improve comprehension and retention of content (Bai et al., 2022), while visual and arts-based instruction helps students better understand abstract concepts (Gorman, 2022). In addition, elaborative interrogation strategies strengthen learning by encouraging students to explain their answers (Killian et al., 2024). Overall, visual tools such as infographics also improve recall and understanding of scientific information (Lee & Lee, 2022), supporting the effectiveness of Dual Coding and Elaborative Interrogation Prompts.

The findings suggested that the integration of Dual Coding and Elaborative Interrogation Prompts positively influenced students' conceptual retention in science. The noticeable increase in the number of students who achieved Very Satisfactory and Outstanding performance levels implied that the intervention helped learners process and retain scientific concepts more effectively. Dual Coding likely enhanced learning by combining verbal explanations with visual representations, enabling students to encode and retrieve information through multiple cognitive pathways.

At the same time, Elaborative Interrogation Prompts (EIP) may have strengthened students' understanding by encouraging them to explain relationships, justify ideas, and connect concepts to prior knowledge. The relatively lower standard deviations among the higher-performing groups also suggested more consistent academic performance among students after the intervention. Furthermore, the reduced number of students who did not meet expectations indicated that the intervention may have helped address learning difficulties and improve students' overall comprehension and retention abilities.

**Table 2**

**Students' Performance in Conceptual Retention in Science After the Implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)**

| Performance               | Frequency | Percentage | M    | SD    |
|---------------------------|-----------|------------|------|-------|
| Outstanding               | 4         | 10.0       | 43.3 | 1.258 |
| Very Satisfactory         | 15        | 37.5       | 39.5 | 1.125 |
| Satisfactory              | 13        | 32.5       | 35.6 | 1.193 |
| Fairly Satisfactory       | 5         | 12.5       | 31.4 | 0.894 |
| Did not meet expectations | 3         | 7.5        | 27.3 | 2.887 |
| Overall Performance       | 40        | 100.00     | 36.7 | 4.44  |

Note: 42–50 (Outstanding); 38–41 (Very Satisfactory); 34–37 (Satisfactory); 30–33 (Fairly Satisfactory); 1–29 (Did Not Meet Expectations)

## **Significant Difference in Students' Performance in Conceptual Retention in Science Before and After the Implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)**

Table 3 presented the significant difference in students' performance in conceptual retention in science before and after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP). The findings revealed a statistically significant difference between the students' performance before and after the intervention, as reflected by the computed t-value and p-value ( $t = 8.50$ ,  $p < .001$ ). Prior to the implementation of Dual Coding and EIP, students obtained a lower mean score ( $M = 29.9$ ,  $SD = 4.49$ ), which increased after the implementation to ( $M = 36.7$ ,  $SD = 4.44$ ). This significant increase in the mean score indicated that the intervention contributed positively to improving students' conceptual retention in science.

The significant finding suggested that the integration of Dual Coding and Elaborative Interrogation Prompts effectively enhanced students' understanding and retention of scientific concepts. The increase in students' mean performance after the intervention implied that combining verbal information with visual representations helped learners process information more efficiently and retain concepts for a longer period. Moreover, Elaborative Interrogation Prompts may have encouraged students to think critically by asking them to explain why concepts occur or how ideas are related, thereby strengthening meaningful learning.

The relatively similar standard deviations before and after the intervention further suggested that the improvement in conceptual retention was consistently experienced by the students. These findings supported cognitive learning theories which emphasized that learning becomes more effective when students actively engage in processing and organizing information through multiple representations and reflective questioning.

There were no non-significant findings observed in the study since the obtained p-value was less than 0.05. This indicated that the improvement in students' conceptual retention was not due to chance but was significantly associated with the implementation of Dual Coding and Elaborative Interrogation Prompts. The rejection of the null hypothesis further confirmed the effectiveness of the intervention in enhancing students' performance in science.

Educational research confirms the effectiveness of Dual Coding and Elaborative Interrogation in enhancing science learning and conceptual retention. Dual Coding improves students' ability to process, organize, and recall information by combining visual and verbal learning pathways (Dogomeo & Aliasas, 2022).

Likewise, elaborative interrogation enhances understanding and critical thinking by encouraging students to explain relationships among concepts (Killian et al., 2024). Self-explanation and elaborative prompts also support meaningful learning and long-term memory retention (Bai et al., 2022). In addition, evidence-based strategies such as elaboration and retrieval practice have been shown to improve overall learning outcomes (Nebel & Sumeracki, 2022). Therefore, these findings support the use of Dual Coding and Elaborative Interrogation Prompts as effective strategies for improving science education.

Science teachers were encouraged to integrate Dual Coding and Elaborative Interrogation (EIP) strategies regularly into classroom instruction to improve conceptual retention and promote deeper understanding of scientific concepts. Teachers could incorporate diagrams, charts, concept maps, animations, and visual organizers alongside guided questioning activities to make lessons more engaging and meaningful.

School administrators were encouraged to provide professional development seminars and workshops that would strengthen teachers' competence in applying evidence-based instructional strategies. Curriculum developers could also design instructional materials and learning modules that integrate visual and verbal learning components with higher-order questioning techniques. Furthermore, schools could organize collaborative learning activities, inquiry-based investigations, and reflective discussions to sustain students' active participation and critical thinking skills. Through the consistent use of these innovative teaching approaches, students may develop stronger conceptual understanding, improved retention, and better academic performance in science.

Table 3

**Significant Difference in Students' Performance in Conceptual Retention in Science Before and After the Implementation of Dual Coding and Elaborative Interrogation Prompts (EIP)**

| Performance                                      | M    | SD   | T-value | P-value | Decision               |
|--------------------------------------------------|------|------|---------|---------|------------------------|
| Before the Implementation of Dual Coding and EIP | 29.9 | 4.49 | 8.50    | <.001   | Reject H <sub>01</sub> |
| After the Implementation of Dual Coding and EIP  | 36.7 | 4.44 |         |         |                        |

Note:  $p < 0.001$  (Highly Significant);  $p < 0.05$  (Significant);  $p > 0.05$  (Not Significant)

**SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS****Summary**

This action research This action research aimed to enhance Grade 8 students' conceptual retention in Science through the integration of Dual Coding and Elaborative Interrogation Prompts (EIP). Specifically, the study determined the students' performance in conceptual retention before and after the implementation of the intervention and examined whether there was a significant difference in students' performance after the application of the strategies. The study was conducted among forty (40) Grade 8 students in one of the public secondary schools in Ozamiz City during the School Year 2025–2026.

The study utilized a classroom-based action research approach using a single-group pretest–posttest design. A 50-item researcher-made test was used to measure students' conceptual retention in Science before and after the implementation of Dual Coding and Elaborative Interrogation Prompts. The instrument underwent content validation and reliability testing to ensure accuracy and consistency. Data gathered were analyzed using frequency, percentage, mean, standard deviation, and paired t-test through Jamovi software.

The intervention was implemented through the integration of visual and verbal learning strategies together with reasoning-based questioning techniques. Students were exposed to diagrams, concept maps, illustrations, and analytical “why” and “how” questions that encouraged meaningful learning and deeper understanding of scientific concepts. The findings of the study revealed that students' conceptual retention significantly improved after the implementation of Dual Coding and Elaborative Interrogation Prompts. The intervention effectively enhanced students' understanding, retention, and overall performance in Science.

**Findings**

The following were the salient findings of the study:

1. The performance of Grade 8 students in Science before the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP) was low.
2. The performance of Grade 8 students in Science after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP) was satisfactory.



3. There was a very highly significant difference in the students' conceptual retention in Science before and after the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP).

## Conclusions

Based on the findings of the study, the following conclusions are drawn:

1. Students demonstrate low conceptual retention in Science before the implementation of Dual Coding and Elaborative Interrogation Prompts (EIP), suggesting that traditional instructional approaches alone are insufficient in promoting deep understanding and long-term retention of scientific concepts.
2. The implementation of Dual Coding and Elaborative Interrogation Prompts (EIP) positively improves students' conceptual retention in Science. The integration of visual representations and reasoning-based questioning strategies enables students to process, organize, and retain scientific information more effectively.
3. The significant increase in students' performance after the intervention confirms that Dual Coding and Elaborative Interrogation Prompts (EIP) are effective instructional strategies for enhancing conceptual retention and understanding in Science. Thus, the integration of these strategies serves as an effective learner-centered approach in improving science instruction and students' academic performance.

## Recommendations

Based on the findings and conclusions, it is recommended that:

1. Science teachers are encouraged to regularly integrate Dual Coding and Elaborative Interrogation Prompts (EIP) into classroom instruction to enhance students' conceptual retention, comprehension, and critical thinking skills.
2. Teachers are encouraged to utilize visual learning materials such as diagrams, flowcharts, concept maps, illustrations, and infographics together with reasoning-based questioning activities to make science lessons more engaging and meaningful.
3. School administrators are encouraged to provide seminars, workshops, and professional development programs that strengthen teachers' knowledge and skills in applying evidence-based instructional strategies such as Dual Coding and Elaborative Interrogation Prompts.
4. Curriculum developers are encouraged to design instructional materials, modules, and learning resources that incorporate visual-verbal integration and higher-order thinking activities to support deeper learning among students.
5. Future researchers are encouraged to conduct similar studies using larger groups of participants, longer intervention periods, or other science disciplines to further validate and expand the findings of this study. The integration of other cognitive and learner-centered strategies may also be explored to enhance conceptual retention and academic achievement in Science.

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