**Improving Science Performance Through Mnemonic Keyword Method Among Fifth-Grade Learners**

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**ABSTRACT**

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| The low science performance among elementary learners highlights the need for innovative and engaging interventions such as the Mnemonic Keyword Method. A mnemonic is a device used to aid memory, which involves associating new information with something more familiar, making it easier to remember. This study aimed to test the effectiveness of the Mnemonic Keyword Method in improving science performance among fifth-grade learners. A quasi-experimental research design was utilized, with the control group receiving science teaching instruction without the intervention and the experimental group receiving science teaching instruction using the mnemonic keyword method. The study employed a researcher-made instrument consisting of 25 items designed to assess learners' performance before and after the intervention. The instrument underwent validity testing (Aiken's V = 0.92) and reliability testing (Cronbach's alpha = 0.714). The findings showed that the experimental group (n = 77) significantly improved (p < 0.000) their science performance compared to the control group (n = 69). This study recommends that science teachers incorporate the Mnemonic Keyword Method into their science teaching to enhance learners' memory and understanding of complex scientific concepts. Teachers can utilize keywords and images in science, both of which should encourage consistent review and provide positive reinforcement to enhance students' learning and improve their science performance. |

*Keywords: Mnemonic keyword method, science performance, dual coding theory, fifth-grade learners, quasi-experimental design, star patterns, memory strategies*

**1. INTRODUCTION**

The ability to understand and apply scientific concepts is crucial for students' academic success, particularly in subjects that involve complex terminology and abstract ideas, such as science. As students advance through their education, the capacity to grasp these concepts becomes crucial not only for academic achievement but also for applying them in real-world situations (NASEM, 2016; Rivas et al., 2023). In elementary education, strengthening science performance at the Grade 5 level is crucial, as it lays the foundation for future learning in higher education and careers, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields (Ahmad & Siew, 2021; Fomunyam, 2021). Grade 5 serves as a pivotal year in the K to 12 curriculum of the Philippines, where students begin to transition from basic knowledge to more complex content in science, such as astronomy and physics (Dogomeo & Aliazas, 2024; Madan, 2017). Targeting this grade level ensures that interventions like the mnemonic keyword method are implemented at a formative stage when students are cognitively ready to benefit from memory-enhancing strategies while still developing foundational scientific knowledge (Patterson et al., 2015).

Globally, science performance remains a significant challenge, particularly in developing countries where educational resources and access to quality teaching methods are often limited (Tan et al., 2023; Rumbley et al., 2023). In the Philippines, low science performance is a significant issue, with many students scoring below international standards on assessments such as the Programme for International Student Assessment (PISA) due to difficulties in grasping abstract scientific principles (Almerino et al., 2020; OECD, 2023). Topics like physics, chemistry, and astronomy pose particular challenges due to their abstract nature (Akram et al., 2022; Hughes, 2023). This is further hindered by limited resources and teaching methods that fail to engage students, leading to lower performance (Adil et al., 2024; Shambare, 2023; Chew & Cerbin, 2021).

In response to this challenge, the study examines the effectiveness of the mnemonic keyword method, an evidence-based approach grounded in cognitive psychology. This method is based on dual coding theory (Paivio, 1986), which suggests that information is more effectively remembered when processed both visually and verbally. By engaging these cognitive pathways, the method has been shown to enhance students' ability to recall and understand complex scientific concepts (Putnam, 2015; Wyra, 2019). The method consists of three steps: recording, relating, and retrieving, which help students create strong associations between verbal keywords and visual images, improving memory retention and understanding (IRIS Center, 2021). This approach is particularly suitable for 5th-grade learners, who are at a developmental stage where visual learning and memory-based strategies are highly effective. Its structure aligns well with the Department of Education’s focus on learner-centered pedagogies and supports the goals outlined in the K to 12 curriculum for developing scientific literacy and critical thinking at the elementary level.

Erikson (2019) reported that children struggle to retain astronomy concepts due to difficulties in understanding abstract thinking and interpreting specialized representations needed to grasp complex spatial relationships. This action research aimed to examine the impact of the mnemonic keyword method on the science performance of Grade 5 learners at Cateel Central Elementary School, specifically in the context of identifying star patterns visible at specific times of the year. By applying this method to two Grade 5 sections, the study aimed to determine whether the mnemonic keyword method can enhance students' science performance, as measured by pre-test and post-test scores.

The significance of this study extends beyond academic performance. By improving students' science performance, this research also aims to foster greater student engagement and motivation in learning (Wang & Wang, 2015; Korankye-Mensah, 2022). Furthermore, this study offers valuable insights for educators, parents, and future researchers interested in integrating effective teaching strategies in science education. The findings could contribute to curriculum development, teaching practices, and policy-making within the Department of Education, particularly in enhancing the engagement and effectiveness of science learning (Law et al., 2021; Mir et al., 2023). By aligning with national education standards and promoting active learning strategies, the study supports curriculum innovation that is both developmentally appropriate and pedagogically sound for Filipino elementary students.

**2. OBJECTIVES**

The primary objective of this study was to enhance the science performance of Grade 5 learners at Cateel Central Elementary School by utilizing the mnemonic keyword method in science lessons on star patterns visible at specific times of the year. The specific objectives were the following:

1. To determine the average test score of the science performance among fifth-grade students measured by pre-test scores in both control and experimental groups.
2. To determine if there is a significant difference in the mean score of pre-test scores between the control and experimental groups.
3. To determine the average test score of the science performance among fifth-grade students measured by post-test scores in both control and experimental groups.
4. To determine if there is a significant difference in the mean post-test scores between the control and experimental groups.
5. To determine the extent to which the keyword mnemonic method improves science performance among fifth-grade students.

**3. MATERIALS AND METHODS**

**Research Design**

This study employed a quasi-experimental research design, which involves manipulating independent variables while controlling for other influencing factors to isolate the effects of the intervention. It enables a clearer understanding of the relationship between the intervention and outcomes by minimizing the impact of external variables and ensuring the reliability and validity of the findings through the control of factors such as prior knowledge, teaching methods, and classroom environment (Andrade, 2021).

**Research Instrument**

This study employed quantitative research to analyze how the mnemonic keyword method improved science performance among fifth-grade learners in the competency of identifying star patterns visible at particular times of the year, using the code S5FEIVi-j-9. The study employed a researcher-designed instrument comprising 25 items to evaluate the learning outcomes of the learners before and after the intervention. It underwent content validity and reliability tests. Content validity was evaluated by three experts, who reviewed the content and its relevance to learning outcomes and objectives, as well as the validity of individual items. Aiken's V coefficient results were at 0.92, reflecting excellent validity. The instrument was pilot-tested in other schools to confirm its reliability, yielding a Cronbach's alpha coefficient of 0.714. These ensured the validity and reliability of the instruments.

**Respondents of the Study**

Grade five students were the respondents of this study at Cateel Central Elementary School. Two sections from the grade five level were selected through random sampling: Grade 5-Jacinto was the experimental group, and Grade 5-Aquino was the control group. Before selecting respondents, the researcher consulted with the school principal and grade five class advisers to identify sections willing to participate. To ensure fairness and avoid bias, a coin toss was conducted with the class advisers to determine which section would serve as the control group and which would be the experimental group.

**Data Gathering**

The data gathering procedure began with the researcher first obtained ethical clearance from the University Research Ethics Board (UREB) to comply with ethical guidelines and safeguard the rights of participants.

After receiving ethical approval, the researcher requested permission from the school principal and grade 5 advisers at Cateel Central Elementary School to conduct the pre-test assessment and the intervention. The request stated the study's purpose, participant involvement, and methodology, ensuring transparency and collaboration with the school administration.

The assent form was first obtained from the parents or guardians of the learners, indicating their willingness for their child to participate in the study. Following this, learners were given time to complete the pre-test assessment, which was designed to determine their initial test performance regarding the lessons on star patterns. The pre-test assessment consisted of multiple-choice questions to establish the students' baseline on science performance.

Following the pre-test, the control group continued with standard instruction, focusing on rote memorization of the material. Students were expected to memorize the information presented through repetition and recall without connecting it to any meaningful context. On the other hand, the experimental group received instruction using the mnemonic keyword method. The three steps —recoding, relating, and retrieving — of the method were embedded in the science lessons. In the recoding phase, the teacher linked the material to a familiar keyword to create a meaningful connection. During the relating phase, students were shown a visual representation to reinforce the keyword. In the retrieving phase, students recalled the keyword and its visuals, strengthening their understanding and retention. This approach engaged both cognitive pathways to enhance recall and understanding of the material, leading to improved scientific performance in the experimental group.

At the end of the two-week intervention period, a post-test assessment was conducted for both the control group and the experimental groups, using the same assessment as the pre-test. This assessment would determine the effectiveness of the keyword mnemonic method by comparing the average test scores for the science performance of both groups before and after the intervention was implemented.

**4. RESULTS AND DISCUSSION**

**Pre-test Scores of the Control and Experimental Group**

Table 1 presents the average test score of the pre-test assessment among fifth-grade students in both control and experimental groups. The control group has a mean score of 6.28 with a standard deviation of 2.67, while the experimental group has a mean score of 6.12 with a standard deviation of 2.55. Both groups fall under the "Did Not Meet Expectations" category, indicating that the initial performance of students in both groups was relatively low before the intervention.

The low pre-test scores can be attributed to several factors, as outlined in the related literature. Students often struggle with science concepts due to cognitive overload, lack of motivation, or ineffective teaching methods, all of which can contribute to lower assessment scores (Grageda, 2022; Mason & Zaccoletti, 2021; Hughes, 2023). This aligns with the observation that many students find science concepts abstract and challenging to retain, leading to poor performance in initial assessments (Akram et al., 2022; OECD, 2023). Erikson (2019) also highlighted that students face challenges in comprehending scientific concepts, especially those that are abstract or require multidimensional thinking, which further supports the idea that complex scientific concepts can hinder understanding and performance. Additionally, the student's prior exposure to scientific content and learning methods may have influenced their initial understanding, further explaining the low pre-test scores.

Table 1: *Level of pre-test scores between the experimental and control group*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Total Score | Standard Deviation | Mean | Transmuted Grade | Remarks |
| Control Group | 25 | 2.67 | 6.28 | 66 | Did Not Meet Expectations |
| Experimental Group | 25 | 2.55 | 6.12 | 66 | Did Not Meet Expectations |

**Difference in Pre-test Scores in Control and Experimental Group**

Table 2 presents a statistical comparison of the pre-test scores between the control and experimental groups. The t-value of 0.217 and p-value of 0.830 suggest that there is no statistically significant difference between the two groups in terms of their pre-test performance. This indicates that both groups were equivalent at baseline in terms of their initial knowledge and understanding before the intervention.

As discussed in the literature, pre-test similarities between groups are not uncommon, especially in studies where students have not been exposed to specific interventions. As de Boer et al. (2015) emphasized, establishing comparability at the start of an experiment is crucial for the validity of subsequent findings. By ensuring that both groups start at a similar level, any observed changes in performance can be attributed more confidently to the intervention rather than pre-existing differences.

The lack of significant differences between groups in the pre-test reflects that these challenges are widespread, affecting students regardless of the instructional method they are initially exposed to (Khelifi & Hamzaoui-Elachachi, 2024; Chew & Cerbin, 2021). Studies have highlighted that students' difficulties in grasping science concepts stem from various educational and cognitive factors, such as the complexity of scientific language and conceptual overload (Avraamidou, 2022; Jia et al., 2024).

Table 2: *Mean comparison between pre-test scores of control and experimental group*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Mean | Standard Deviation | t-value | p-value | Interpretation |
| Control Group | 6.28 | 2.67 | 0.217 | 0.830 | There is no significant difference in the average pre-test score between the experimental and control groups. |
| Experimental Group | 6.12 | 2.55 |

**Post-test Scores of the Control and Experimental Group**

Table 3 presents the mean score for science performance on star patterns, as measured by post-test scores, between the control and experimental groups. The study compared the post-test scores of two groups: a control group that received standard curriculum instruction and an experimental group that utilized the mnemonic keyword method to learn star patterns. The experimental group has a mean score of 16.12 with a standard deviation of 4.15, falling into the "Fairly Satisfactory" category. In contrast, the control group's mean score is 9.52 with a standard deviation of 3.06, still within the "Did Not Meet Expectations" category. This substantial difference suggests a positive impact of the mnemonic keyword method on students' science performance on the topic of star patterns. Since both groups are equivalent groups at baseline, any observed changes in performance can be confidently attributed to the intervention rather than pre-existing differences.

The post-test results highlight the potential of mnemonic keyword strategies in improving students' science performance. Given that science education often involves memorizing difficult terminology and concepts, methods that help students retain information more effectively can lead to better academic outcomes (Putnam, 2015; Horwitz, 2020). These findings suggest that the mnemonic keyword method could be a valuable tool for educators to help students engage with and retain complex scientific content, ultimately improving their understanding and performance in science education (Lin et al., 2016; Sharma & Tripathi, 2024).

The use of mnemonic strategies in science education has been shown to enhance students' retention of complex scientific concepts and terminology (Ejaz & Oyibo, 2024). In particular, the mnemonic method enhances recall by forming strong associations between unfamiliar scientific terms and familiar images or concepts, leading to improved science performance (Wyra, 2019; Cancino et al., 2021). This approach likely contributed to the improvement observed in the experimental group, as it aligns with findings that such memory-enhancing techniques help reduce cognitive overload, a major barrier to learning in science (Kurniarahman, 2023; Korankye-Mensah, 2022).

**Table 3.** *Level of post-test scores between the control and experimental groups*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Total Score | Standard Deviation | Mean | Transmuted Grade | Remarks |
| Control Group | 25 | 3.06 | 9.52 | 69 | Did Not Meet Expectations |
| Experimental Group | 25 | 4.15 | 16.12 | 77 | Fairly Satisfactory |

**Difference in post-test scores in the Control and Experimental Group**

Table 4 shows the post-test scores of the control and experimental groups. The t-value of 6.406 and p-value of 0.000 indicate a statistically significant difference between the two groups. This finding indicates that the intervention implemented with the experimental group had a notable impact on their performance, resulting in higher post-test scores compared to the control group.

The significant difference in post-test scores between the control and experimental groups highlights the educational value of the mnemonic keyword method in teaching star patterns among grade five learners. Students in the experimental group, who learned with the aid of the mnemonic keyword method, scored significantly higher than those in the control group, which received science instructions focused on rote memorization. This suggests that the use of verbal and visual elements helped improve their ability to identify star patterns. Previous studies support this finding, showing that active learning, where students engage directly with the material through visualization and association, has been shown to improve retention and understanding (Joshua & Smith, 2017; LaDue et al., 2015; Tibell & Harms, 2017). By using the intervention, the experimental group was able to make connections between abstract scientific concepts and more concrete, familiar imagery, which enhanced their science performance (Verónica, 2021; Putnam, 2015; National Research Council, 2015). Therefore, the statistical significance of this difference supports the effectiveness of the mnemonic keyword method in enhancing science learning outcomes when compared to standard teaching methods used with the control group.

Moreover, the result also underscores the importance of adopting more interactive and student-centered learning strategies in science education. It highlights that when students are actively engaged in the learning process, particularly through the use of memory aids and visualization techniques, their performance can significantly improve (Wang & Wang, 2015; Noonan, 2023; Larsen, 2018). This suggests that science educators should consider integrating mnemonic methods into their curriculum to enhance student learning and retention, particularly in subjects that involve complex and abstract concepts (Raiyn, 2016; Yun, 2023).

**Table 4**. Mean comparison between*post-test scores of the control and experimental groups*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Mean | Standard Deviation | t-value | p-value | Interpretation |
| Control Group | 9.52 | 3.06 | 6.406 | 0.000 | There is a significant difference in the average post-test score between the experimental and control group. |
| Experimental Group | 16.12 | 4.15 |

**Effect Size of Mnemonic Keyword Method in Improving Science Performance**

As shown in Table 5, the keyword mnemonic method has a substantial impact on science concept retention among fifth-grade learners. Cohen's d coefficient (1.812) indicated a very large effect size, confirming that the mnemonic keyword method had a strong effect on improving the science performance of the experimental group.

The effect size is consistent with previous research that has highlighted the efficacy of mnemonic methods in educational settings. Cohen (1988, as cited in Goulet-Pelletier & Cousineau, 2018) stated that an effect size of 0.8 or above represents a very large effect, and the results here far exceed this threshold. This large effect size indicates that the educational intervention—such as the use of a mnemonic keyword method—had a meaningful impact on student learning outcomes. Translating this into percentile terms makes the impact even more tangible: a student who initially scores at the 20th percentile would, following the intervention, improve to approximately the 87th percentile. This 67.04 percentile point gain, or approximately 67%, represents not just statistical significance but a considerable shift in academic ranking and classroom performance (Guarino et al., 2015; Wright, 2018). Large effect sizes in education are especially valuable as they often indicate practical improvements that both educators and learners can directly observe in real classroom environments (Kraft, 2020; Slemrod et al., 2022).

Similarly, the large effect sizes observed in this study highlight the effectiveness of the mnemonic keyword method in improving performance in science education. This method helps students associate complex scientific concepts with familiar keywords, making them easier to recall (Kurniarahman, 2023). By creating a strong mental link between the keyword and the target information, the mnemonic keyword method facilitates the retention and retrieval of abstract concepts, which is crucial in subjects such as science (Cancino et al., 2021; Attygalle et al., 2025). The success of this method in improving science performance aligns with previous research demonstrating its ability to enhance both memory and learning outcomes in students (IRIS Center, 2021; Fung & Oyibo, 2024).

The effectiveness of the mnemonic keyword method can be anchored to the dual coding theory, which suggests that memory is improved when information is processed through both verbal and visual systems. This dual-channel approach enables students to develop more robust mental representations, facilitating easier recall and application of learned material (Heard, 2017; Paivio, 1971; Wu & Molnár, 2022). The integration of verbal and visual processing in the mnemonic keyword method is supported by research showing that combining these two systems leads to better memory retention and learning outcomes in elementary science education (Borghi et al., 2017; Mir et al., 2023; Rexigel et al., 2024).

**Table 5.** *Effect Size of Mnemonic Keyword Method on Post-Test Scores in Identifying Star Patterns*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Measures | | Standardizer | Point Estimate | 95% Confidence Interval | |
| Lower | Upper |
| Post-Test | Cohens’d | 3.643 | 1.812 | 2.467 | 1.143 |

**5. CONCLUSIONS AND RECOMMENDATIONS**

**Conclusion**

Anchoring to the findings of the study, the researchers concluded the following:

1. The pre-test results indicated that both the control group (M = 6.28) and the experimental group (M = 6.12) exhibited low test performance and did not meet expectations prior to the intervention.
2. The mean comparison between the pre-test scores suggested no significant difference (p = 0.830) in the mean scores between the experimental and control groups.
3. The control group's post-test scores (M = 9.52) did not meet expectations, whereas the experimental group's scores (M = 16.12) were fairly satisfactory.
4. The mean comparison between the post-test scores revealed a significant difference (p = 0.000) in the average scores between the experimental and control groups.
5. A very large effect size (d = 1.812) was observed in the experimental group's post-test scores compared to those of the control group, confirming that the mnemonic keyword method had a strong positive impact on improving science performance.

These findings confirm that the mnemonic keyword method significantly enhances science performance among Grade 5 learners. The success of the method can be attributed to its theoretical foundation in dual coding theory, which emphasizes the use of both verbal and visual processing to strengthen memory and understanding (Paivio, 1986). By engaging learners in creating visual imagery linked to verbal keywords, the method supports deeper cognitive encoding and easier retrieval of abstract scientific concepts—an approach particularly effective in subjects like astronomy where spatial and conceptual complexity is high.

The study demonstrated that the application of dual coding theory through the mnemonic keyword method leads to substantial improvement in learners’ science performance, validating the theory’s relevance and effectiveness in actual classroom practice. Therefore, the connection between the cognitive processes described in dual coding theory and the observed outcomes in science performance is both evident and significant. This highlights the value of integrating evidence-based, theory-driven strategies into science instruction, especially at the elementary level where foundational understanding is crucial.

**Recommendation**

1. A qualitative study may be conducted to explore the root causes of why neither the control nor the experimental group met expectations. This can involve interviews, focus groups, or classroom observations to identify factors such as prior knowledge gaps, motivation issues, or teaching methods that could have influenced students' performance.

2. Exploring other teaching strategies to complement the mnemonic keyword method is encouraged. Approaches such as inquiry-based learning, hands-on experiments, or cooperative learning may enhance student engagement and help deepen their understanding of scientific concepts, accommodating different learning styles and improving overall science performance.

3. It is recommended to examine the factors within the mnemonic keyword method that contributed to only "Fairly Satisfactory" results in the experimental group. Aspects such as the complexity of the concepts, the duration of the intervention, or students' prior knowledge may be explored to identify areas for further refinement of the method.

4. Focusing on the improvement of the mnemonic keyword method's implementation is important. Providing teachers with more detailed training on how to integrate the method effectively into their lessons and ensuring active student participation in creating associations between verbal keywords and visual images will likely enhance its impact.

5. Replicating the study across different grade levels and science topics would be beneficial. This could provide a broader understanding of the effectiveness of the mnemonic keyword method in various educational contexts and subject areas, enabling more effective adaptations to meet the diverse needs of learners and different settings.

6. Educators are encouraged to adopt the mnemonic keyword method as a practical, theory-driven strategy to improve science instruction. Its basis in dual coding theory, which leverages both visual and verbal learning channels, has proven to be a powerful aid in enhancing science concept retention among elementary students. Practical application of this method in real classrooms can transform abstract science topics into more accessible and engaging learning experiences.

**Ethical Approval:**

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

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Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1. Chat GPT 4.0

- Help me make 4 subtitles of RRL for my action research - Make this introduction cohesive.

- Help me dicuss this statistical results base from my RRL.

- Please correct the grammar of these paragraphs.

- Please make me a cohesive scope and delimitation with the following conditions....

- What theory woud be the best fit for our action research with our proposed intervention?

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