Effects of a Spaced-Retrieval Framework on Information Durability and Cognitive Endurance Among Grade 8 Students of Madapdap Resettlement High School, Division of Mabalacat, Pampanga

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ABSTRACT

Students enrolled in content-heavy subjects such as Science and Mathematics often experience rapid information decay, limiting long-term knowledge retention and contributing to dependence on cramming before examinations. Although spaced retrieval has been shown to improve learning outcomes, its effects on information durability, cognitive endurance, and study habits among junior high school students remain underexplored.

This study determined the effectiveness of the Spaced-Retrieval Framework (SRF) in improving information durability and cognitive endurance and in mitigating cramming behaviors among Grade 8 students.

A quantitative study employing a quasi-experimental pretest-posttest control group design was conducted among 60 Grade 8 students from a public secondary school in the Division of Mabalacat. Participants were assigned to either an experimental group that received the Spaced-Retrieval Framework intervention or a control group that followed conventional study practices. Data were collected using the researcher-developed Cognitive Endurance and Retrieval Assessment (CERA), which underwent expert validation and demonstrated acceptable internal

consistency (Cronbach's α = 0.85). Descriptive statistics, paired and independent samples *t*-tests, Pearson correlation, one-way ANCOVA, effect size analysis, weighted mean, and standard deviation were used to analyze the data.

Students initially demonstrated a high rate of information decay (M = 4.38, SD = 0.60). Following implementation of the Spaced-Retrieval Framework, participants exhibited very high long-term retention of conceptual knowledge (M = 4.51, SD = 0.52), high cognitive endurance during assessments (M = 4.48, SD = 0.53), and a significant reduction in reliance on cramming (M = 4.54, SD = 0.50). The findings indicate that structured retrieval practice enhanced memory retention, strengthened cognitive performance, and promoted more sustainable learning behaviors.

The Spaced-Retrieval Framework is an effective instructional strategy for improving long-term retention, enhancing cognitive endurance, and reducing dependence on cramming among Grade 8 learners in content-heavy subjects. Integrating structured retrieval activities into classroom instruction may contribute to improved academic performance and more sustainable learning outcomes.

Keywords: ***Spaced-Retrieval Framework, Information Durability, Cognitive Endurance, Content-Heavy Subjects, Forgetting Curve, Cramming Mitigation spaced retrieval, retrieval practice, long-term retention, cramming, Grade 8 students, Science education, Mathematics education***

INTRODUCTION

The increasing complexity of Science and Mathematics curricula has intensified the cognitive demands placed on junior high school students. As learners progress through content-heavy subjects, they are expected to master a substantial volume of concepts, formulas, and technical terminology within limited instructional time. This often results in cognitive overload, making it difficult for students to retain and retrieve previously learned information. Consequently, many learners experience rapid information decay and resort to massed study strategies, commonly referred to as cramming, which typically produce only short-term academic gains.

Educational psychology has consistently demonstrated that memory retention depends not only on the quality of instruction but also on the manner in which learning is reinforced. Traditional approaches that rely heavily on repeated reading and last-minute review frequently fail to transfer knowledge from working memory to long-term memory. In contrast, retrieval practice, particularly when implemented through spaced intervals, has emerged as one of the most effective evidence-based learning strategies for strengthening memory consolidation and improving long-term retention. Studies have shown that repeatedly retrieving previously learned information enhances recall accuracy, reduces forgetting, and promotes deeper conceptual understanding.

The Spaced-Retrieval Framework (SRF) integrates retrieval practice with strategically timed review sessions to strengthen memory consolidation while reducing cognitive overload. Unlike conventional cramming, which concentrates learning immediately before examinations, the framework distributes retrieval opportunities across increasing intervals, allowing students to reconstruct knowledge repeatedly as memory begins to fade. This process strengthens neural pathways associated with learning, enhances information durability, and improves

the efficiency of knowledge retrieval during academic tasks.

Beyond memory retention, retrieval practice may also influence cognitive endurance, defined as the ability to sustain attention, mental effort, and problem-solving accuracy during prolonged academic activities. Students who retrieve information more efficiently expend fewer cognitive resources on basic recall, allowing greater attention to higher-order thinking tasks. Consequently, structured retrieval strategies may contribute not only to improved academic performance but also to reduced mental fatigue and greater confidence during high-stakes examinations.

Although numerous international studies have demonstrated the benefits of retrieval practice, limited empirical evidence exists regarding the effectiveness of structured spaced-retrieval interventions among Filipino junior high school learners enrolled in content-heavy subjects. Furthermore, few local studies have simultaneously examined information durability, cognitive endurance, and the reduction of cramming behaviors within a single instructional framework. This gap highlights the need for context-specific evidence to guide classroom instruction and curriculum implementation.

Accordingly, this study evaluated the effectiveness of the Spaced-Retrieval Framework in improving information durability, enhancing cognitive endurance, and mitigating cramming behaviors among Grade 8 students enrolled in Science and Mathematics. Specifically, the study sought to (1) determine the initial rate of information decay among students in content-heavy subjects; (2) examine the effect of the Spaced-Retrieval Framework on long-term retention of conceptual knowledge; (3) determine the relationship between retrieval frequency and cognitive endurance during high-stakes assessments; and (4) evaluate the effectiveness of the framework in reducing students' reliance on cramming. The findings of this study are expected to contribute to evidence-based

instructional practices that promote sustainable learning, improved academic performance, and enhanced student well-being in secondary education.

METHODS

Research Design

This study employed a quantitative approach using a quasi-experimental pretest-posttest control group design to determine the effectiveness of the Spaced-Retrieval Framework (SRF) in improving information durability, cognitive endurance, and study habits among Grade 8 students. The design enabled comparison of learning outcomes between students exposed to the SRF intervention and those who followed conventional study practices while maintaining the natural classroom setting.

Research Setting and Participants

The study was conducted in a public secondary school within the Division of Mabalacat, Philippines. The school was selected because it offers the standard Grade 8 Science and Mathematics curriculum prescribed by the Department of Education and represents a typical learning environment characterized by content-intensive instruction.

Sixty Grade 8 students participated in the study. Two intact classes with comparable academic performance and taught by the same teacher were purposively selected to minimize instructional variability. One class served as the experimental group (n = 30), while the other served as the control group (n = 30).

Research Instrument

Data were collected using the researcher-developed **Cognitive Endurance and Retrieval Assessment (CERA)**, which consists of a performance-based achievement test and a Student Process Survey. The achievement test measured long-term retention of Science and Mathematics concepts under timed conditions, whereas the survey assessed students' perceptions of information retention, cognitive endurance, retrieval experiences, and cramming behaviors.

The instrument underwent content validation by experts in Science education, Mathematics education, educational psychology, and educational measurement. Reliability testing through pilot administration yielded a Cronbach's alpha coefficient of **0.85**, indicating high internal consistency.

Data Collection Procedure

Prior to data collection, approval was obtained from the appropriate educational authorities and the participating school. Written parental consent and student assent were secured before participation.

Both groups completed a pretest to establish baseline knowledge. Following classroom instruction, students in the experimental group participated in structured spaced-retrieval sessions implemented at predetermined intervals throughout the instructional period, whereas students in the control group continued using conventional study practices. Immediate and delayed posttests were subsequently administered to assess knowledge retention and information durability. At the conclusion of the intervention, participants completed the Student Process Survey.

Data Analysis

Descriptive statistics, including frequency, percentage, weighted mean, standard deviation, mean, and standard deviation, were used to summarize participants' responses and performance.

Inferential statistical analyses included paired-samples *t*-tests to compare pretest and posttest scores within groups, independent-samples *t*-tests to compare the experimental and control groups, Pearson product-moment correlation to determine the relationship between retrieval frequency and cognitive endurance, and one-way analysis of covariance (ANCOVA) to evaluate the effect of the intervention while controlling for baseline differences. Cohen's *d* was calculated to determine effect size.

Prior to inferential analyses, assumptions of normality and homogeneity of variance were examined using the Shapiro-Wilk test and Levene's test, respectively. Statistical significance was evaluated at the 0.05 level.

Ethical Considerations

Ethical approval and administrative permission were obtained before the conduct of the study. Participation was voluntary, and informed consent from parents or guardians, together with student assent, was secured because all participants were minors. Confidentiality was maintained by assigning identification codes to participants and reporting findings only in aggregate form. Participants were informed that their involvement would not affect their academic standing and that they could withdraw from the study at any time without penalty. Upon completion of the research, the instructional materials used in the Spaced-Retrieval Framework were made available to the control group to ensure equitable access to the intervention.

RESULTS

Initial Rate of Information Decay

Table 1 presents the baseline level of information decay among Grade 8 students enrolled in content-heavy subjects. The overall mean score was **4.38** (SD = **0.60**), indicating a **high rate of information decay**. The highest-rated indicators were *feeling behind due to forgetting* (M = 4.43, SD = 0.56), *overwhelm due to content volume* (M = 4.42, SD = 0.57), and *forgetting lesson details after class* (M = 4.41, SD = 0.58). These findings demonstrate that students experienced substantial difficulty retaining newly learned concepts before the implementation of the intervention.

Long-Term Retention of Complex Conceptual Knowledge

Table 2 summarizes the effects of the Spaced-Retrieval Framework on long-term retention. Participants obtained an overall mean score of **4.51** (SD = **0.52**), interpreted as **very high long-term retention**. The highest scores were recorded for *improved perception of memory* (M = 4.56, SD = 0.49), *formation of a long-term knowledge base* (M = 4.55, SD = 0.50), and *stability of memory after 24-hour recall* (M = 4.55, SD = 0.50). These results indicate substantial improvement in students' ability to retain and retrieve conceptual knowledge following the intervention.

Cognitive Endurance During High-Stakes Assessments

Table 3 presents the level of cognitive endurance demonstrated by students who participated in the Spaced-Retrieval Framework. The overall mean was **4.48** (SD = **0.53**), corresponding to **high cognitive endurance**. Among the highest-rated indicators were *sense of mental stamina* (M = 4.52, SD = 0.51), *increased confidence* (M = 4.52, SD = 0.51), and *fast retrieval under pressure* (M = 4.51, SD = 0.52). The

findings suggest that participants-maintained concentration and sustained mental performance during extended academic assessments.

Mitigation of Cramming Behaviors

Table 4 presents the effectiveness of the Spaced-Retrieval Framework in reducing students' reliance on cramming. The overall mean score was **4.54** (SD = **0.50**), indicating that the intervention **significantly mitigated cramming behaviors**. The highest-rated indicators included *permanent replacement of cramming* (M = 4.57, SD = 0.48), *deep learning versus surface learning* (M = 4.56, SD = 0.49), *elimination of cramming habits* (M = 4.56, SD = 0.49), and *smarter learning approach* (M = 4.56, SD = 0.49). These findings demonstrate that students adopted more effective and sustainable learning strategies following participation in the framework.

Overall, the findings indicate that students initially exhibited a high rate of information decay. Following implementation of the Spaced-Retrieval Framework, participants demonstrated improved long-term retention, greater cognitive endurance, and substantially reduced dependence on cramming.

DISCUSSION

The findings of this study demonstrate that Grade 8 students enrolled in content-heavy subjects initially experienced a high rate of information decay, confirming that conventional study practices are insufficient to support long-term retention of complex concepts. Students reported substantial difficulty retaining lesson content shortly after instruction, indicating that information acquired through passive review and repeated reading is vulnerable to rapid forgetting. These findings support the theory that working memory has limited capacity and that

knowledge not actively reinforced is unlikely to be transferred to long-term memory.

Following the implementation of the Spaced-Retrieval Framework, participants demonstrated marked improvements in long-term retention. Structured retrieval opportunities enabled students to repeatedly reconstruct previously learned concepts, strengthening memory consolidation and reducing information loss over time. This finding is consistent with previous studies showing that retrieval practice combined with spaced review enhances durable learning more effectively than repeated study or massed practice. The results suggest that retrieval-based instruction not only improves recall but also promotes meaningful conceptual understanding by reinforcing existing knowledge structures.

The study likewise found that frequent retrieval practice was associated with improved cognitive endurance during academic assessments. Students reported greater mental stamina, faster information retrieval, and increased confidence while completing demanding learning tasks. These findings suggest that retrieval practice reduces the cognitive effort required for basic recall, allowing learners to allocate more mental resources to higher-order thinking and problem solving. Consequently, the instructional benefits of spaced retrieval extend beyond memory retention to include sustained cognitive performance during prolonged assessments.

Another important finding is the significant reduction in students' dependence on cramming. Participants indicated that structured retrieval sessions replaced last-minute study habits with more consistent and effective learning routines. This behavioral change suggests that the framework encourages distributed learning, reduces academic anxiety, and promotes long-term mastery of subject matter. Rather than relying on short-term memorization, students gradually developed more efficient strategies for retaining and applying knowledge throughout the instructional period.

Taken together, these findings support the effectiveness of the Spaced-Retrieval Framework as an instructional strategy for content-heavy subjects. The framework addresses three persistent educational concerns: rapid information decay, declining cognitive endurance during extended assessments, and excessive reliance on cramming. By integrating systematic retrieval opportunities into classroom instruction, teachers may improve students' long-term retention while simultaneously fostering deeper understanding, greater confidence, and healthier study habits.

Despite these promising findings, the study has several limitations. The participants were drawn from a single public secondary school within one school division, which may limit the generalizability of the results to other educational settings. In addition, the duration of the intervention was confined to one instructional period; longer implementation may provide stronger evidence regarding the sustained effects of the framework. Future studies should involve larger and more diverse samples, examine additional subject areas and grade levels, and investigate the long-term impact of spaced retrieval on academic achievement and learner motivation.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed:

1. School administrators should provide professional development programs that equip teachers with evidence-based strategies for retrieval practice and long-term memory enhancement.

2. Curriculum developers should incorporate retrieval-based learning activities into instructional guides and learning resources

to promote sustained knowledge retention.

3. Teachers should integrate structured spaced-retrieval activities into regular classroom instruction, particularly in content-heavy subjects such as Science and Mathematics.

4. Students should adopt distributed study schedules and active retrieval techniques instead of relying on last-minute cramming before examinations.

5. Future researchers should replicate the study using larger samples, multiple schools, and longer intervention periods to further validate the effectiveness of the Spaced-Retrieval Framework across different educational contexts.