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Spaced Learning Method in Improving Scientific Literacy Skills and Performance in Science 10

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Abstract*—The main purpose of the study is to determine the effect of the Spaced Learning Method on learners' scientific literacy skills and performance in Science 10. This research also aims to determine the extent of spaced learning method and its key learning strategies such as: spaced repetition, time allocation and spaced practice; in the level of learners' scientific literacy skills in terms of: conceptual understanding, conceptual explanation and scientific inquiry in terms of their performance between experimental and control group and the significant difference between the learners' level of scientific literacy skills in terms of formative test. Descriptive research design was utilized, applying weighted mean and standard deviation for data analysis, and multiple linear regression to evaluate the effect of the Spaced Learning Method. Forty-five Los Baños Integrated School (LBNHS) Grade 10 students were purposively chosen to be respondents. The results showed that the Spaced Learning Method, and the main strategies used in it, had a remarkable positive impact on learners' scientific literacy skills, especially in the areas of concept understanding and explanation. The experimental group demonstrated a higher degree of ability in scientific literacy compared to the control group. Their experimental presentation performance was graded as "Outstanding," reflecting significant improvement in their skill to explain scientific concepts and execute scientific procedures. Although the important learning strategies (spaced repetition, time allocation, and spaced practice) were found to be useful, although they did not reflect a strong direct impact on learners' performance when presenting experiments. The research concludes that the Spaced Learning Method greatly improves learners' scientific literacy skills and their presentation skills for experiments. It suggests that teachers integrate spaced learning techniques into science courses to ensure improved retention and comprehension of scientific principles. Additional research is suggested to examine the ideal spacing intervals and how they affect learning outcomes*.

***Keywords*—** *Spaced Learning; Scientific Literacy Skills; Performance in Science*.

I. INTRODUCTION

The Program for International Student Assessment (PISA) assesses scientific skill conducted by the Organization for Economic Cooperation and Development (OECD) through evaluations in the domains of reading, mathematics, and scientific competencies of youths aged 12 to 15.(Amini & Sinaga, 2021).

In a general manner, under the K-12 Curriculum the spiral progression of topics in science subjects allows the blend in of different topics from Grade 7-10. This also allows a break in from difficult topics that we have from a junior high school journey. But the most important factor is the mastery of each topic and the application of each topic through performance task. Hence the learners must develop scientific literacy which will give them an edge for the succeeding topic. As the teacher strives to promote mastery of the lesson, we also try different teaching strategies and learning methodologies inside the classroom, additional hands -on activities or improvised materials and sometimes a new learning method and strategies that we can adapt.

Space learning method was based on the concept of learning through repetition at certain interval, it can be done by breaking task or concept with distractor activity or allocating modules into several sections to promote learning and development of long-term memory.

The success of the teaching-learning process lies in both teacher and learner factor. In a classroom situation learning can happen if the teacher can expand the learning method and teaching strategy and the learner accepts the way the teacher taught its' lesson. The interaction between the teacher and the students is a genuine part of learning which contributes most of the learning experience aside from the activities in the classroom. Cultivating academic literacy is a key aim of K-12 education. Academic literacy is described as the skill necessary to derive meaning in subject-specific areas typically linked to education (e. g., science, social studies, English language arts; Torgesen et al., 2017). As teachers strive to put a lot of effort in the teaching process with various strategies and learning method, newly emerging method of teaching and learning paved its way for testing. In this study the Spaced Learning Method and its' effect in learners' scientific literacy skills and performance will be tested.

1.1 Statement of the Problem

Specifically, it sought to answer the following questions:

1. *What is the extent of utilizing Spaced Learning Method as key learning strategies in terms of the following:*
   - *1.1. Spaced Repetition;*
   - *1.2. Time Allocation; and*
   - *1.3. Spaced Practice?*
2. *What is the level of learners' performance in scientific literacy skills between control and experimental group in terms of the following:*
   - *2.1. Conceptual Understanding;*
   - *2.2. Conceptual Explanation; and*
   - *2.3. Scientific Inquiry?*
3. *What is the level of learners' performance in practical in terms of experimental presentation?*

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4. *Is there a significant difference in the level of learners 'performance in scientific literacy skills between control and experimental group?*
5. *Is there a notable distinction in the performance levels of learners in experimental presentation between the control and experimental group?*
6. *Does the extent of utilizing spaced learning method have a significant effect on learners' performance in scientific literacy skills?*
7. *Does the extent of utilizing spaced learning method have a significant effect in learners' performance in practical test in experimental presentation?*

II. METHODOLOGY

This study used Quantitative Research by nature. It applies a quasi-experimental approach to identify the effectiveness of the Spaced Learning Method. According to Thomas (2020), the quasi-experimental design aimed to establish a cause-and-effect relationship between an independent and dependent variable, like a true experiment. The application of the Spaced Learning Method serves as the cause and the improvement of scientific literacy and performance as the effect.

This study utilized a between-subjects design. Utilizing a between-subjects design, the transfer of knowledge was not a concern — participants are never exposed to multiple levels of the same independent variable. (https://www.nngroup.com/articles). The Spaced Learning Method was applied to the Experimental Group, and the Traditional K-12 Approach was applied to the Control Group.

III. RESULTS AND DISCUSSION

This chapter presents the different results and discusses the results from treating the data gathered in this study. All specific questions in Chapter 1 under the statement of the problem are answered in this chapter, supported by tables. It presents the data gathered about the significant effect of Spaced Learning Method as a key learning strategy and learners' performance in Scientific Literacy Skills and Experimental Presentation. In particular, the study addresses the following:

Extent of utilizing the Spaced Learning Method as key learning strategies

In this study, the extent of utilizing Spaced Learning Method as key learning strategies refers to Spaced Repetition, Time Allocation, and Spaced Practice. The data gathered from the questionnaire given to the experimental group were tabulated and analyzed. Through these data, the researcher was able to gather important insights from the learners. With that data, the researcher proved that key learning strategies were within the grasp of learners.

Tables 1 to 4 highlighted the extent of learners' agreement for the key learning strategies. The survey questionnaire utilized a five (5) point-rating scale with the following verbal interpretation: 5- Strongly Agree; 4- Agree; 3- Neither Agree nor Disagree; 2- Disagree and 1- Strongly Disagree.

Learners from the experimental group were the respondents of this survey questionnaire as they received the treatment from the Spaced Learning Method and its key learning strategies.

The following tables show the statement, mean and standard deviation, remarks, and verbal interpretation from the perspectives of respondents.

Table 1. Extent of utilizing Spaced Learning Method in terms of Spaced Repetition

Statements	***Mean***	***SD***	***Remarks***
Spaced repetition makes me remember scientific concepts better.	4.11	0.68	Agree
Spaced repetition helps me recognize facts from observation.	4.20	0.59	Agree
Spaced repetition allows me to break down topics into smaller and manageable examples.	3.87	0.69	Agree
Spaced repetition improved my understanding of scientific concepts.	3.96	0.74	Agree
I feel more confident in my scientific knowledge after using spaced repetition.	3.71	0.66	Agree
Weighted Mean	**3.97**		
SD	**0.69**		
Verbal Interpretation	**Great Extent**		

The data from Table 1 represents the extent of spaced repetition as key learning strategies on learners' perception during the implementation of the spaced learning method. The highest mean score was obtained from statement number 2, Agree. It only implies that learners perceive repetition to be of great help for them to recognize facts from observations. The lowest mean score from statement number 5 implies that learners feel confident in the scientific knowledge they gained, verbally interpreted as "agree". The overall mean score of 3.97, verbally interpreted as "great extent", only indicates that learners perceive spaced repetition as beneficial in developing scientific literacy skills.

The following table are the data gathered for the extent of Time Allocation.

Table 2. Extent of utilizing Spaced Learning Method in terms of Time Allocation

Statements	***Mean***	***SD***	***Remarks***
The time allocated to each activity helps me understand and grasp the concepts more clearly.	4.18	0.68	Agree
The time allocated for each problem helps me analyze the data and draw conclusions.	4.20	0.59	Agree
Spacing out the time makes challenging concepts easier to understand over time.	3.87	0.76	Agree
The time allocated for each experiment helps me connect variables and develop hypotheses.	3.96	0.67	Agree
The time allocation helps me follow the procedure and improve my performance with a better understanding.	4.04	0.56	Agree
Weighted Mean	**4.05**		
SD	**0.66**		
Verbal Interpretation	**Great Extent**		

Another data point from Table 2 represents the findings of the extent of time allocation in the spaced learning method as perceived by the learners. The highest mean score was from statement number 2, with 4.20 verbally interpreted as "agree". The lowest mean from statement number 3 with 3.87, verbally interpreted as "agree". Overall, it implies that time allocation allows learners' understand and break down topics, making it

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easier for learners to grasp. Spacing out the schedule allows for interval making learning effective.

Table 3. Extent of utilizing Spaced Learning Method in terms of Spaced Practice

Statements	*Mean*	*SD*	*Remarks*
Spaced practice helps me learn difficult terms and theories.	4.11	0.68	Agree
Through spaced practice, I can now provide a better explanation of theories.	4.00	0.80	Agree
Spaced practice helps me apply concepts to examples more quickly.	4.11	0.80	Agree
Spaced practice helps me present variables and their relationship easily.	3.96	0.77	Agree
Spaced practice helps me break down and analyze data gradually.	4.11	0.61	Agree
Weighted Mean	**4.06**		
SD	**0.73**		
Verbal Interpretation	**Great Extent**		

Data in Table 3 shows the extent of spaced practice as key learning strategies in the spaced learning method. There were three statements that obtained the highest mean of 4.11: statements 1, 3, and 5. This implies the positive effect of spaced practice in learning difficult terms and theories, plus the application of concepts.

Table 4. Composite of Spaced Learning Method

Indicators	*Weighted Mean*	*SD*	*Verbal Interpretation*
Spaced Repetition	3.97	0.69	Great Extent
Time Allocation	4.05	0.66	Great Extent
Spaced Practice	4.06	0.73	Great Extent
Grand Mean	**4.03**		
SD	**0.69**		
Verbal Interpretation	**Great Extent**		

The extent of utilizing Spaced Learning Method in terms of Spaced Repetition, Time Allocation**,** and Spaced Practice. arrived at a grand mean score of 4.03 and a standard deviation of 0.69, and was verbally interpreted as a *great extent* among the respondents. This means that the extent of utilizing the Spaced Learning Method has a great extent on learners. Spaced practice had the highest mean of 4.06, while spaced repetition had 3.97, and time allocation with a mean of 4.05 were all verbally interpreted as a great extent in terms of learners' statement of agreement. It only means that learners perceive the spaced learning method as effective in their learning process.

Table 5. Level of Students' Performance in Science 10- Third Quarter in terms of Formative Test

Raw Score	**Students' Performance**					
	Control			**Experimental**		
	f	**%**	**Verbal Interpretation**	**F**	**%**	**Verbal Interpretation**
33-40	2	4%	Advance	6	13%	Advance
25-32	8	18%	Proficient	33	74%	Proficient
17-24	31	69%	Approaching Proficiency	6	13%	Approaching Proficiency
9-16	4	9%	Developing	0	0%	Developing
1-8		0%	Beginning	0	0%	Beginning
Total	45	100%		45	100%	
	Mean = 22.49 SD = 4.59		**Approaching Proficiency**	Mean = 28.82 SD = 3.50		**Proficient**

For the control group the majority of students (69%) fall under the "Approaching Proficiency" level, with a mean score of 22.49, confirming this performance level. There was a small percentage (4%) reached the

"Advanced" level, while 18% were "Proficient." While there were few students (9%) were still in the "Developing" stage, and none were in the "Beginning" level. Overall, this incites that most students in the control group have basic scientific literacy skills but are not yet fully proficient.

From the experimental group a significant improvement was observed. Majority (74%) of students are at the "Proficient" level, and 13% have reached the "Advanced" level. The mean score is 28.82, verbally interpreted as "Proficient" in category. There was only 13% are still "Approaching Proficiency," and but no students fall into the "Developing" or "Beginning" levels.

The following data table shows the difference between the scientific literacy skills of the learners from the control and experimental groups in their written formative test.

Table 6. Level of performance in scientific literacy skills between the control and experimental groups in terms of Conceptual Understanding

Score	**Control**		**Experimental**		**Descriptive Equivalent**
	F	**%**	**F**	**%**	
13 – 15	0	*0.00*	2	*4.44*	Outstanding
10 – 12	6	*13.33*	10	*22.22*	Very Satisfactory
7 – 9	20	*44.44*	28	*62.22*	Satisfactory
4 – 6	17	*13.78*	5	*11.11*	Fairly Satisfactory
1 – 3	2	*0.00*	0	*0.00*	Did not meet Expectations
Total	**45**	***100***	**45**	***100***	
Weighted Mean	*6.89*		*8.82*		
SD	*2.32*		*1.98*		
Verbal Interpretation	*Fairly Satisfactory*		*Satisfactory*		

The data from Table 5 shows that the Experimental Group had a larger percentage of students in higher performance categories "Very Satisfactory" and "Satisfactory" compared to the Control Group. This only suggests that the Spaced Learning Method had a significant effect on their Conceptual Understanding of scientific literacy.

The Weighted Mean for the Experimental Group is higher, indicating that, on average, they performed better than the Control Group. The Standard Deviation also shows that the Experimental Group's performance was more consistent.

The data suggests that the Experimental Group showed a higher level of Conceptual Understanding in scientific literacy, with more students achieving higher performance levels compared to the Control Group. The Spaced Learning method used with the Experimental Group has contributed to this improvement.

The following table shows data for the comparison of the level of performance in terms of conceptual explanation.

Data in Table 7 shows that the Experimental Group generally performed better in scientific literacy skills in terms of conceptual explanation compared to the control group. They had a higher percentage of students in the "Outstanding" and "Very Satisfactory" categories and no students falling in the "Fairly Satisfactory" or "Did not meet Expectation" categories.

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Table 7. Level of performance in scientific literacy skills between the control and experimental groups in terms of Conceptual Explanation

Score	Control		Experimental		Descriptive Equivalent
	F	%	F	%	
13 – 15	1	*2.22*	5	*11.11*	Outstanding
10 – 12	10	*22.22*	22	*48.89*	Very Satisfactory
7 – 9	17	*37.78*	18	*40.00*	Satisfactory
4 – 6	16	*35.56*	0	*0.00*	Fairly Satisfactory
1 – 3	1	*2.22*	0	*0.00*	Did not meet Expectations
Total	**45**	***100***	**45**	***100***	
Weighted Mean	*7.71*		*10.16*		
SD	*2.76*		*1.169*		
Verbal Interpretation	*Satisfactory*		*Very Satisfactory*		

The control group performed more evenly, with a significant percentage of students in the "Satisfactory" and "Fairly Satisfactory" categories, indicating that while many students performed adequately, fewer achieved higher levels of understanding.

Although the experimental group has a low percentage of outstanding, on the contrary, they have no percentage of learners in fairly satisfactory and did not meet expectations, as compared to the control group. This only indicates a significant improvement in the level of scientific literacy in terms of conceptual explanation. Based on the data gathered, the hypothesis" There is no significant difference in the mean level of learners' Scientific Literacy skills between control and experimental group is rejected based on the result of the formative test.

Table 8. Level of performance in scientific literacy skills between the control and experimental groups in terms of Scientific Inquiry

Score	Control		Experimental		Descriptive Equivalent
	F	%	F	%	
13 – 15	0	*0.00*	3	*6.67*	Outstanding
10 – 12	5	*11.11*	23	*51.11*	Very Satisfactory
7 – 9	32	*71.11*	19	*42.22*	Satisfactory
4 – 6	8	*17.78*	0	*0.00*	Fairly Satisfactory
1 – 3	0	*0.00*	0	*0.00*	Did not meet Expectations
Total	**45**	***100***	**45**	***100***	
Weighted Mean	*5.98*		*9.84*		
SD	*1.985*		*1.609*		
Verbal Interpretation	*Fairly Satisfactory*		*Satisfactory*		

Level of learners' performance in the formative test

In this study, the level of learners' scientific literacy skills in the formative test, which refers to Conceptual Understanding, Conceptual Explanation, and Scientific Inquiry.

The control group has a large portion of students in the "Satisfactory" category (71.11%) and a smaller portion in the "Very Satisfactory" and "Fairly Satisfactory" categories. The overall performance of the control group is leaning towards an adequate level but not exceeding expectations significantly.

The experimental group performs better overall, with a higher percentage of students in the "Very Satisfactory" (51.11%) and "Outstanding" (6.67%) categories. There are no students in the "Fairly Satisfactory" category, and the group has fewer students in the "Satisfactory" category (42.22%) than the control group, indicating better overall performance.

This means that the hypothesis, "There is no significant difference in the mean level of learners' Scientific Literacy skills between the control and experimental group," is rejected.

Table 9. Level of Learners' Experimental Presentation in Control and Experimental Group

Score	Control			Experimental		
	M	SD	VI	M	SD	VI
Menstrual Calendar	11.81	0.31	VS	12.63	0.12	O
Extracting DNA	11.56	0.10	VS	12.99	0.17	O
Unearthing the past	11.35	0.14	VS	12.63	0.05	O

The data in Table 8 suggests that the learners have improved in the experimental presentation significantly. The data shows that within the three practical tests in the form of experimental presentation, control group performance was interpreted as "very satisfactory" while for the experimental group, the performance was interpreted as "outstanding". The hypothesis "There is no significant difference in the level of learners' experimental presentation between the control and experimental group is rejected. There is a significant difference between the level of performance of the control group and the experimental group. The experimental group outperformed the control group in the three experimental presentations.

Table 10. Test of Difference in the Learners' Performance in Experimental Presentation between Control and Experimental Group

Learners 'Performance in Experimental Presentation	Control Group		Experimental Group		Mean Difference	t	p
	M	SD	M	SD			
Menstrual Calendar	3.70	0.43	4.12	0.29	0.422	3.41	0.001*
Extracting DNA	3.54	0.49	4.08	0.35	0.54	3.64	0.001*
Unearthing the Past	3.37	0.47	4.13	0.59	0.76	4.71	0.000*

*Note: *p<.05*

The mean difference of 0.422 indicates that the Experimental Group scored higher than the Control Group on the Menstrual Calendar task. The t-

value of 3.41 is relatively large, indicating a strong difference between the groups. The p-value of 0.001 is less than the significance threshold of 0.05, meaning that the difference in performance between the two groups is statistically significant. This implies that Experimental Group performed significantly better than the Control Group on the Menstrual Calendar task.

The mean difference of 0.54 suggests that the Experimental Group had a higher mean score compared to the Control Group on the Extracting DNA task. The t-value of 3.64 is significant, showing a large difference in the performance of both groups. The p-value of 0.001 indicates a statistically significant result ($p < 0.05$), meaning the difference is unlikely to have occurred by chance. Overall, this only means that Experimental Group outperformed the Control Group in the Extracting DNA task, and this difference is statistically significant.

The mean difference of 0.76 shows that the Experimental Group performed better than the Control Group on the Unearthing the Past task. The t-value of 4.71 is very large, suggesting a strong statistical difference between the two groups. The p-value of 0.000 indicates a very strong statistical significance, far below to 0.05, confirming that the difference in performance is highly significant. This only means that Experimental Group performed significantly better than the Control Group in the Unearthing the Past task, with a very statistically significant result.

In relation to the findings given from the study made by Noor et al., Spaced Learning Method was developed to address the challenges individuals face in retaining information and reduce the rate of forgetting, which can contribute positively to academic performance.

Table 11. Test of Difference in Learners' Performance in Scientific Literacy Skills between Control and Experimental Groups

Learners' performance in scientific literacy skills	Control Group		Experimental Group		Mean Difference	t	P
	M	SD	M	SD			
Conceptual Understanding	6.89	5.37	8.82	3.92	1.93	5.93	0.000*
Conceptual Explanation	7.71	7.62	10.16	3.04	2.44	6.78	0.000*
Scientific Inquiry	7.89	2.15	9.84	2.59	1.96	6.22	0.000*

*Note: *p<.05*

The table displays the outcome of the test for the difference in learners' performance and compares the mean and standard deviation of both the control and experimental groups.

The Experimental Group performed better than the Control Group in Conceptual Understanding, with a statistically significant difference (p = 0.000). The mean difference of 1.93 also suggests that learners in the Experimental Group have a higher level of conceptual understanding than those in the Control Group. This means that the hypothesis 'There is no significant difference in the level of learners' experimental presentation of control and experimental group in terms of conceptual understanding' is rejected based on the result of the t=5.93 and the level of significance p = 0.000, from p < 0.05.

This implies that learners from the experimental group recognize facts from the experiment and establish a connection between the facts and the observation they had made. It also indicates that learners can now apply facts and concepts as they discussed the results and conclusions from their experiment. Those results are the indication that learners from the experimental group have gained conceptual understanding.

The Experimental Group also performed better than the Control Group in Conceptual Explanation, with a significant difference (p = 0.000). The mean difference of 2.44 shows that the Experimental Group had a considerably higher ability to explain concepts. This means that the hypothesis 'There is no significant difference in the level of learners' experimental presentation of control and experimental group in terms of conceptual explanation' is rejected based on the result of the t=6.78 and the significant difference (p = 0.000) from p < 0.05. In the study made by Irawan 2024, there is a significant correlation between scientific literacy skills and scientific explanation skills that have an integral effect on creative thinking skills. That is why the data showed a slight variation because conceptual explanation is somewhat related to creative thinking. This only means that conceptual explanation is beyond the words and their meaning, but more about how the scientific concepts connect from learners' observation to facts and real application of those facts to natural phenomenon and the conciseness of the statement whether it is a hypothesis, findings, or conclusion from their presentation, and in written words.

This implies that learners were able to discuss the experiment through facts and scientific concepts, and provided enough relationships between variables. The results of the experiment were also discussed through scientific concepts with clarity.

The Experimental Group again performed better than the Control Group in Scientific Inquiry, with a significant difference (p = 0.000). The mean difference of 1.96 indicates that the Experimental Group had better scientific inquiry skills. This implies that learners were able to present a hypothesis very well and also determine the variables in the experiment. During the experiment, they were able to follow the procedure properly and record the data. After the experiment, they were able to analyze the data, leading to a valid and comprehensive conclusion and recommendation.

From the results presented, we can conclude that at the 0. 05 significance level, the null hypothesis "There is no significant difference in the learners' performance in scientific literacy skills between control and experimental group" is dismissed, suggesting that there is a considerable difference between the two. The difference between the result shows significant improvement in the scientific literacy skills among learners from the experimental group.

In general, within the three areas of scientific literacy skills (Conceptual Understanding, Conceptual Explanation, and Scientific Inquiry), the Experimental Group outperformed the Control Group, with statistically significant results (all p-values are less than 0.05). This suggests that the Spaced Learning Method applied to the Experimental Group positively affected their performance in scientific literacy skills.

Table 12

Test of Effect on Using the Spaced Learning Method and the Learners' Performance in Scientific Literacy Skills

Spaced Learning Method	Learners' performance	Beta	*SE*	β	*p*
Spaced Repetition	Conceptual understanding	-0.030	0.796	-1.637	0.046*
Time allocation		2.808	0.847	1.098	0.202
Spaced practice		0.791	0.752	-0.727	0.339
Spaced Repetition	Conceptual explanation	0.315	0.726	-1.152	0.121
Time allocation		1.661	0.772	0.102	0.896
Spaced practice		1.231	0.686	-0.154	0.824
Spaced Repetition	Scientific Inquiry	0.970	0.677	-0.587	0.561
Time allocation		1.548	0.720	0.131	0.897
Spaced practice		0.544	0.639	-1.169	0.249

*Note: *p<.05*

The table shows the result of Beta = -0.030, and the p = 0.046: The result is statistically significant, suggesting that Spaced Repetition has a negative but small effect on learners'

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conceptual understanding. A decrease in performance in conceptual understanding might be associated with the use of Spaced Repetition. The table also shows the result of Beta = 2.808, and the p = 0.202. The p-value is greater than 0.05, so this result is not statistically significant. Time Allocation does not seem to have a significant impact on learners' conceptual understanding in this context. This table also shows the result of Beta = 0.791, and the p = 0.339. This result is not statistically significant, indicating that Spaced Practice does not have a significant effect on learners' conceptual understanding.

This table also shows the result of Beta = 0.315, and the p = 0.121: The p-value is greater than 0.05, so the result is not statistically significant. The result of Beta = 1.661, and the p = 0.896 for time allocation. This result is also not statistically significant, indicating no significant effect of Time Allocation on learners' ability to explain concepts. Lastly, the result of Beta = 1.231, and the p = 0.824. Again, the result is not statistically significant, meaning Spaced Practice does not significantly impact learners' ability to explain concepts. Spaced Repetition, Time Allocation, and Spaced Practice do not significantly affect learners' conceptual explanation.

The result of Beta = 0.970, and the p = 0.561 means it is not statistically significant, meaning that Spaced Repetition does not have a significant effect on learners' ability to engage in scientific inquiry. For time allocation, the result shows Beta = 1.548, and the p = 0.897: The p-value is greater than 0.05, indicating no significant effect of Time Allocation on scientific inquiry. Lastly, the result of Beta = 0.544, and the p = 0.249. This result is not statistically significant, suggesting Spaced Practice does not significantly affect scientific inquiry skills.

The only statistically significant result is the effect of Spaced Repetition on Conceptual Understanding, which shows a small negative relationship (Beta = -0.030). This suggests that, in this particular study, Spaced Repetition might be somewhat have a small negative effect on learners' conceptual understanding in scientific literacy. Time Allocation and Spaced Practice generally do not show significant effects across the different aspects of learners' performance in scientific literacy (conceptual understanding, conceptual explanation, scientific inquiry). The Utilization of Spaced Learning Method key learning strategies has no significant effect on the Learners' Performance in Experimental Presentation.

This table presents the results of an analysis investigating the effect of the Spaced Learning Method on learners' performance in experimental presentations. The study focuses on three different experimental presentations: Menstrual Calendar, Extracting DNA, and Unearthing the Past.

For Menstrual Calendar (Experimental Presentation 1), Spaced Repetition (Beta = 0.731, p = 0.237), the p-value is greater than 0.05, meaning the effect of Spaced Repetition on performance in this presentation is not statistically significant. Also for Time Allocation (Beta = 0.562, p = 0.761): The p-value is greater than 0.05, indicating that Time Allocation does not have a significant impact on performance in the Menstrual Calendar presentation. Spaced Practice (Beta = 0.160, p = 0.210): The p-value is greater than 0.05, showing that Spaced Practice does not significantly affect performance in this presentation.

Table 13

Significant effect between the Spaced Learning Method and the Learners' Performance in Experimental Presentation

Spaced Learning Method	Experimental Presentation	Beta	*SE*	β	*p*
Spaced Repetition	Menstrua calendar (experimental presentation 1)	0.731	0.227	0.273	0.237
Time allocation		0.562	0.242	0.074	0.761
Spaced practice		0.160	0.214	-0.273	0.210
Spaced Repetition	Extracting DNA (experimental presentation 2)	0.650	0.257	0.131	0.611
Time allocation		0.298	0.273	-0.253	0.360
Spaced practice		0.501	0.242	0.012	0.962
Spaced Repetition	Unearthing the Past (experimental presentation 3)	0.883	0.330	0.216	0.517
Time allocation		0.783	0.351	0.073	0.836
Spaced practice		0.709	0.312	0.079	0.802

*Note: *p<.05*

For experimental presentation, Extracting DNA (Experimental Presentation 2), Spaced Repetition (Beta = 0.650, p = 0.611): The p-value is greater than 0.05, suggesting that Spaced Repetition does not significantly affect performance in the Extracting DNA presentation. Time Allocation (Beta = 0.298, p = 0.360): The p-value is greater than 0.05, indicating that Time Allocation does not have a significant effect on performance in this experimental presentation. Spaced Practice (Beta = 0.501, p = 0.962): The p-value is greater than 0.05, meaning Spaced Practice has no statistically significant impact on performance in Extracting DNA.

For Unearthing the Past (Experimental Presentation 3), Spaced Repetition (Beta = 0.883, p = 0.517): The p-value is greater than 0.05, suggesting that Spaced Repetition does not significantly affect performance in the Unearthing the Past presentation. Time Allocation (Beta = 0.783, p = 0.836): The p-value is greater than 0.05, indicating no significant effect of Time Allocation on performance in this experimental presentation. Spaced Practice (Beta = 0.709, p = 0.802): The p-value is greater than 0.05, suggesting no significant effect of Spaced Practice on learners' performance in Unearthing the Past.

In general, all three experimental presentations (Menstrual Calendar, Extracting DNA, and Unearthing the Past), none of the components of the Spaced Learning Method (Spaced Repetition, Time Allocation, Spaced Practice) show statistically significant effects on learners' performance.

All p-values are greater than 0.05, meaning that none of these learning methods significantly impacted learners' ability to perform in the experimental presentations studied.

The results suggest that, in this analysis, Spaced Repetition, Time Allocation, and Spaced Practice do not appear to significantly improve learners' performance in these specific experimental tasks.

In summary, the extent of utilization of the spaced learning method has no significant effect on learners' performance in the practical test in experimental presentation in the abovementioned experiments.

A positive result in the academic performance was observed through the formative test based on the data given, but the key learning strategies had no significant effect on the learner's performance in experimental presentation, but had a

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significant effect on the mean level of their performance in the formative test.

IV. Conclusion and Recommendations

Based on the findings above the following conclusions were hereby drawn:

1. A considerable difference exists in the learners' performance in scientific literacy skills between control and experimental group. Based on the result from the gathered data that experimental group performed better than the control group, Spaced Learning Method has a positive effect in the academic performance of the learners.
2. There is a significant difference in the learners' performance in experimental presentation between control and experimental group. Significant improvement in the experimental presentation was noted during the study. Learners were able to discuss the experiment through scientific facts and explain the result thoroughly providing relationship between variables and the procedures were followed properly. These observations indicate the improve scientific literacy skills during the study.3. Spaced learning method has a significant effect on learners' scientific literacy skills and performance in Science 10. This means that Spaced Learning Method can be considered as an alternative learning method can be utilized to improve scientific literacy skills and performance in science curricula. But the key learning strategies have no significant effect on the learners' performance.

Therefore, the difference in the mean level in the formative test of learners only shows that experimental group performed better than the control group showing the significant effect of spaced learning method in terms of written test which measures their level of conceptual understanding, conceptual explanation and scientific literacy. In the level of performance in terms of experimental presentation, learners from the experimental group was rated and given the verbal interpretation of Outstanding, suggesting improvement in their scientific literacy skills but in the analysis with the use of the test of effect spaced learning method key learning strategies namely: spaced repetition, time allocation and spaced practice has no significant effect in the performance of the learners.

The main factor that this study use is the spacing out of topics, activities and concept, this only means that the Spaced Learning Method itself was effective already even without the specified key learning strategies. Spaces created during the learning process allows learners to build episodic memory which then retrieved from time to time as the lesson or topic goes on. Leading to a better conceptual understanding and conceptual explanation of concepts and relating it to observation. Furthermore, spacing out of concept and built in memory added additional skills in scientific inquiry providing learners better performance during experimental presentation.

In the formulated conclusions from the findings, it was recommended that:

1. Science teachers may integrate spaced learning method in their teaching- learning process in science curricula, to improve scientific literacy skills and performance by increasing mastery of scientific concept. Structure lessons which include spaces in concept to allow revisiting.
2. Teachers may prioritize spacing out of concept and lesson or activities to provide learners distributed learning leading to better retention and understanding of concept.
3. Teachers are also encouraged to develop set of evaluating tool or align assessment to measure scientific reasoning, variables explanation and application of procedures.

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