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MICROLEARNING IN SCIENCE: ITS EFFECTS ON KINDERGARTEN 2 LEARNERS' RETENTION

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ABSTRACT

This study focused on examining the effects of microlearning on the retention of science concepts among kindergarten 2 learners of Thai-Singapore International School, with the goal of enhancing instructional strategies in early childhood Science Education. Specifically, the study sought to determine whether delivering science content in short, focused, and engaging "bite-sized" lessons could improve learners' memory retention, comprehension, and mastery compared to conventional teaching methods. Using a Solomon Four-Group Experimental Design, about 160 students were randomly allocated to four groups: two control groups exposed to conventional instruction, and two experimental groups exposed to instruction aided by microlearning. To examine potential testing effects, one of the control groups and one of the experimental groups took a pre-test prior to instructional delivery, may it be conventional or microlearning. Two science topics: 'Heart, lungs, and where the food goes' and 'Animals: Their food, movement and habitat' were used in the intervention. Pre-test scores across some groups indicated comparable baseline knowledge. Post-test results showed higher performance in the experimental groups: 60% of students scored 11–15 points for the first topic, while almost 70% scored 21–25 points for the second topic, compared to lower and more evenly distributed scores in the control groups. These findings suggest that microlearning effectively enhances retention, comprehension, and mastery of scientific concepts in preschool learners. The study contributes to the growing evidence supporting microlearning as a practical instructional strategy in Preschool Science Education and provides insights for curriculum development, lesson design, and teaching practices aimed at improving learning outcomes in young learners.

Keywords: *Microlearning, Science Education, Kindergarten Learners, Early Childhood Education, Learning Retention, Short Instructional Activities, Cognitive Development*

INTRODUCTION

Science is among the predominantly important school subjects due to the skills it helps students develop. Science plays a vital role in technological advancement and discoveries especially in this information age. Shaping the minds of the next generation, that will inherit the world, will help carry on with these advancements.

Rogel (2023) pointed out that Science should be implemented during the early years of education to prepare and expose young learners to basic scientific skills and concepts. Paget's Theory of Cognitive Development stated that by the age 2 to 7 years old, learners operate symbolically, through remembering words and pictures to represent objects. Retaining and processing this information in a science lesson is a reasonable skill for students to acquire at this level.

The extensive nature of scientific knowledge makes it challenging to learn because students need strong learning retention abilities to handle the volume of information. Throughout the years teachers have utilized multiple educational methods to enhance student learning retention. The main difficulty for science teachers involves supporting students who forget their learned material because of excessive information.

Micro-learning is one of the emerging teaching strategies which promise to enhance student learning retention according to recent trends. According to Monib et al., (2025) "microlearning is an instructional approach that delivers targeted bite-sized content to diverse learners, typically lasting from few seconds to a few minutes, each designed to achieve a specific objective". The "forgetting curve" concept which describes the natural tendency to forget details creates avenues for microlearning technique using small learning segments to enhance retention and capacity (Nikkhoo et al., 2023). The strong claim about better retention abilities could lead to improved student memory of lessons. In this experimental research, the researcher seeks to discover if microlearning could lead to better retention in preschool learners learning of science.

This study aims to determine the effects of microlearning on kindergarten 2 learners' retention in their learning in science. The experimental study application of this approach enables teachers to develop lessons which enhance learners' retention abilities that science students need to master. The science lessons content will be divided into "bite-sized content" and will be delivered to preschool learners. The result of this study may help teachers create lessons that are simple to grasp and easy to learn.

Background of the Study

Teaching and improving children's early development of scientific competencies has been a prime concern across countries in this present-day society (Houng, 2024). Even though the learning of science in preschool is not as difficult as learning science in primary and secondary years, preschool learners must acquire the required scientific skills in learning science too. Science education aims for students' scientific literacy and comprehension to improve, and produce responsible citizens (Akram et al., 2024). Through learning these scientific skills, young learners will understand how the world works. Raven and Wenner (2022) compared science to other disciplines and stated that science has its own way for children to see and delve around them and interconnect with the subject matter.

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In some schools, science is taught as early as preschool level, believing that prompt preparation will help students improve throughout the years. Thai-Singapore International School, an international school in Thailand, is one of those schools who offer science education as early as Nursery 2, which is currently adhering to Singaporean curriculum. Science preschool teachers in TSIS see the need of finding an effective way to improve preschool learners' mastery of the lesson. The teachers noticed the difficulty of the subject matter due to the introduction of alien words to young learners who are not frequently exposed to it, and the amount of information that they need to recall. The subject is challenging at all levels, a sentiment that extends to preschool learners. Even elementary schools encounter challenges in learning science, classified as determinants, which one of its external determinants are unfamiliar scientific jargons, the massive content to memorize and complexity of understanding (Viratama & Maskhuliah, 2023). Memory retention, to acquire scientific literacy, are skills required to do well in this subject.

Numerous strategies exist that have been used to acquire the mastery of the lesson and the ability to effectively recall information. These emerging strategies each make great promises of good results. Microlearning is a rising teaching trend in today's digital era. Microlearning delivers bite-sized content to improve learner's retention and engagement (Samala et al., 2023). Al-Sheri (2021) suggests that microlearning offers a practical way to address challenges associated with contemporary tech-focused learning. The strong statements regarding microlearning's benefits and the thorough outline of its key features, opens doors for a possibility of utilizing the said strategy to make learning science effective and feasible.

In search for an effective teaching strategy so the young learners may improve retention in the most effective way, the researcher sees microlearning as a technique that can be used in improving the instruction delivery through preparing the science lessons for preschoolers that is easy to remember. The success of this study may also give insights into how microlearning strategy can be utilized productively.

Science Education in Preschool

Science education in the early years is as important as it is in the later years of education. Thai-Singapore International School, an international school in Thailand, adheres to the Singaporean curriculum, which integrates science curriculum from preschool. TSIS aligns its goal with the curriculum with the belief that science concepts are important and should be taught as early as preschool. Following are studies supporting the inclusion of science in early childhood curricula, highlighting its numerous cognitive and developmental benefits.

Preschool science education fosters young learners' attainment of the knowledge in science and nature, while promoting the enhancement of important scientific competencies like awareness of the environment, proposing hypothesis, logical reasoning and thinking (İncesu et al., 2025). Since these scientific skills support lifelong learning and create analytical competences among students in making socio-scientific decision (Roy et al. 2025). In research carried out by Mambetalina et al. (2023) has showed that 52% of the learners who attended preschool regularly exhibited a high level of scientific thinking while those who has less than 20% attendance has poor scientific skills.

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Learning science experience is universally accepted as integral to the development of the young learners' scientific knowledge and inquiry skills (O'Connor et al., 2021). Moreover, it has been reported that early science immersion potentially supports a wide range of developments including language learning, creativity, strengthening functioning skills, minimizing gender and socio-economic gaps, enhanced science learnings in later grades and overall contribution to school readiness (Roy et al. 2025; Raven and Wenner 2022). Further studies on the science education in preschool years clearly needed focus and further scrutiny to provide the need of structured and effective pedagogical strategies that will help enhance science learning in early years.

Trundle et al. 2023 indicated that mental load may greatly affect learners to process new information that might hinder learning. Considering the inadequate capacity of young minds to process cognitively, guided inquiry-based instructional strategy may lead to an effective way for young learners to engage and learn science concepts. For example, Yıldız Taşdemir and Güler Yıldız (2024) reported "that children need learning experiences that will improve their sensory development, observation and questioning skills". Interestingly, the study also reported that learners primarily wanted to learn about scientists, learn through hands-on experience, and use research equipment.

Studies on Retention in Preschool Learners

Science literacy can be complex subject when introduced to preschool learners due to a variety of technical terms. Learning among young children may vary due to several external factors such as the learning center's instructional language, societal stand, educational qualifications of the parents and learning materials at home (Roy et al. 2025). As reported in the study of Tanui et al. (2020) the school environment plays a crucial role for learner's retention and thus sufficient pre-school amenities are necessary to aid in the learning process. Ritter (2021) revealed various factors that may influence learning and retention like, the learner's characteristics and personal attributes, learner's individual capacities and motivations, task characteristics and context, training system and instructional conditions, environmental factors, interval factors, test conditions, and performance and knowledge metrics.

Memory is the backbone of human cognitive process, which is crucial to learning. Thus, it is necessary to comprehend how factors like age and learning preferences may potentially impact it (Gupta, 2025). Gupta's (2025) study results revealed that young learners have lower memory scores, second to elderly, regardless of whether its recalling through pictures or words. Matbagon (2023) and her team showed that working memory and cognitive flexibility of 5-year-old students are lower although they exhibit higher test scores in moderate to high development across different progression stages, cognitive abilities, and linguistic diversity.

The first step to improve cognitive memory is knowledge, therefore, individuals with more advanced memory capacity are more intelligent. It was also highlighted that activities that trains memories are effective in developing memory retention (Aydoğan & Özyürek, 2020). Aydoğan & Özyürek claims are directly relevant to microlearning due to the fact that knowledge can be delivered in an engaging, concise and systematic approach in the said strategy. Microlearning have strong claims of strengthening learners' retention through repetition and focused exposure to a specific subject matter. It aligns

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with the assertion that during the critical cognitive development of the learners, microlearning may be effective in developing memory retention.

Studies on Microlearning

Microlearning, according to Monib et al. (2025), is a strategy that provides snippets of lessons—short and goal-focused contents, crafted to accomplish a specific learning goal. Al-Sheri (2021) reveals the benefits of microlearning strategy, and it includes improved acquisition of information, enhanced motivation, active engagement and practical skill development through short, focused and interactive educational experience.

Widyakusuma & Sudibyo (2024) pointed out that lengthy lessons are ineffective because it may reduce learner's attention and retention. On the other hand, microlearning's characteristics such as short, focused sessions match the modern learner's predisposition and intellect (Widyakusuma & Sudibyo, 2024). Microlearning is well-directed, offer concise but specific lessons that lasts only between two to eight minutes (Widyakusuma & Sudibyo, 2024).

Fitria (2022), enumerates six benefits of microlearning namely, adaptability across context, short completion time, flexibility for diverse learning styles, customizability to meet specific needs, digestibility of contents that increases retention and comprehension, and accessibility for learners with limited time. Furthermore, Fitria (2022) stated that microlearning is highly effective in teaching and learning because it improved retention—through short animated videos and infographic materials that can not only get catch their attention but are easy to remember, it is easy to update by teachers—due to its short content, it is efficient—the materials are divided into smaller sub-materials that can be easily understood, it is easy to evaluate learning outcomes—because concise topics are easier to assess, and the learning is personal—students can choose the material relevant to their need.

Judijanto (2025) recognized microlearning as a tool that has been widely acknowledge for delivering adaptable, available and stimulating learning opportunities conforming to the fundamentals of lifelong learning. Microlearning design is applicable in advance educational levels and across other subject areas that will facilitate students' mastery of the course and supporting teachers to reach intended learning objectives (Simaremare et al. 2025). Simaremare et al. (2025) believed that microlearning model must be enhanced so students will achieve mastery and comprehension of the subject matter effortlessly.

Microlearning contributes significantly in the promotion of ongoing learning of Generation Z students which as are characterized as learners with short concentration period and are conditioned to acquire information through digital resources quickly (Sutarman et al. 2025). Moreover, Sutarman et al. (2025) pointed out that to break down the material into bite-sized, comprehensible parts, microlearning paves the way to adaptable, productive, and objective learning without causing a cognitive overload.

The developmental needs of learners, especially of today's generations of learners, shows that they may benefit from the microlearning approach of learning instruction. It also directly supports the cognitive capacity of kindergarten 2 learners who naturally struggle with retention and keeping their focus. This study builds a premise that

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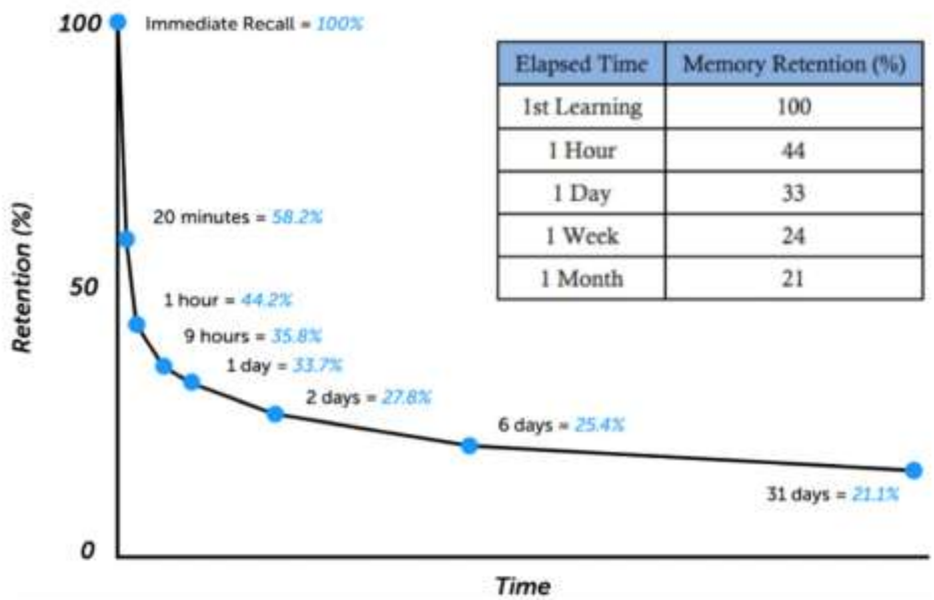
microlearning's efficiency in content delivery can significantly improve the retention of scientific concepts among young learners.

Theoretical Framework

This study drew upon Piaget's cognitivism theory (1936). The theory states that during Preoperational Stage (ages 2-7 years old), learners are thinking symbolically but not logically, very egocentric, struggle with abstract concepts and learns best through play, hands-on experiences and visual aids. To help kindergarten 2 learners retain information or concepts in science, learners should be taught in ways on how the learner's brain naturally processes information.

As noted in more recent perspectives, including those of Ertmer and Newby (1994), "cognitive theories focus on the conceptualization of a student's learning processes and address issues of how information is received, organized, stored, and retrieved by the mind" (Michela, 2018). How the learners acquire the information matters most in this study. Unfortunately, not everything that is learnt retains. Hermann Ebbinghaus study on memory describes human memory through a "forgetting curve", and stated that overtime, it fades (Michela, 2018).



Elapsed Time	Memory Retention (%)
1st Learning	100
1 Hour	44
1 Day	33
1 Week	24
1 Month	21

***Figure 1. Ebbinghaus Curve or Curve of Forgetting*.**

Learners can have higher immediate recall of the subject matter, yet as time goes by, learners might find difficulty in retrieving the information taught. Ebbinghaus classified factors that may affect learning: information's significance, presentation and physiological factors redirecting learner's attention This study will be based on this theory, while incorporating both the cognitive and forgetting curve theories. It is expected that the outcome of this study will somehow offer a potential solution on how to increase learner's retention span while maintaining quality output of education.

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Research Questions

This experimental research aims to test the impact of microlearning strategy in the kindergarten 2 learner's retention in Science. Specifically, the researcher wants to determine if delivering information in smaller content may lead to better retention compared to the traditional approach. Through an experimental study of kindergarten 2 learners, this study will gather evidence to find out the impact on the learning of science of the participants. It aimed to answer the following questions:

1. What are the post-test scores of the kindergarten 2 learners in the control group with pre-test?
2. What are the post-test scores of the kindergarten 2 learners in the control group without the pre-test?
3. What are the post-test scores of the kindergarten 2 learners in the experimental group with pre-test?
4. What are the post-test scores of the kindergarten 2 learners in the experimental group without the pre-test?
5. Is there a significant difference between the kindergarten 2 learners' post-test scores of the control group with pre-test and the post-test scores of the experimental group with pre-test?
6. Is there a significant difference between the kindergarten 2 learners' post-test scores of the control group without the pre-test and the post-test scores of the experimental group without the pretest?
7. Is there a significant difference between the test scores of the kindergarten 2 students in the control group and experimental group?
8. What program can be recommended based on the findings of the study?

Hypotheses

1. Microlearning strategy has no significant effect on the kindergarten 2 learners' post-test scores of the pre-test-post-test experimental group.
2. Microlearning strategy has no significant effect on the kindergarten 2 learners' post-test scores of the post-test only experimental group.
3. Microlearning strategy has no significant effect on kindergarten 2 learners' retention in science.

Scope and Delimitation

This research project is centered on the effects of microlearning strategy to the kindergarten 2 learners' retention of Thai-Singapore International School (TSIS). TSIS is sited at 448 Moo 5 Srinakarin Rd. Samrong Nuea Mueang Samutprakan, Thailand. This experimental study includes a group of 160 heterogenous preschool learners of kindergarten 2. The research experimentation took place during the first term of the academic year 2025-2026 starting from the 6th to the 24th of October. These preschool learners were divided into 4 equal groups comprising 40 learners per group. The research pursued to limit the study only on the learners' retention through an assessment that was

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be given to the sample population. Supplementary scientific abilities, including critical thinking, anticipating outcomes, and problem-solving, were not tested in this study.

METHODOLOGY

Research Design

This quantitative study followed the **Solomon Four-Group Experimental Design.** This research sought to assess how microlearning affects the retention of science concepts among kindergarten 2 students at Thai-Singapore International School. The research involved 160 students, distributed across eight classes, with 20 to 21 students per class. Random assignment placed the classes into four groups: two control and two experimental. Control Group 1 (CG1) underwent a pre-test before receiving lessons in TSIS conventional teaching method, while Control Group 2 (CG2) were taught the same lessons without undergoing a pre-test. Experimental Group 1 (EG1) took a pre-test then, received microlearning aided lessons, while Experimental Group 2 (EG2) were taught lessons aided with microlearning instructions with then took a post-test only. To encourage further scrutiny of the findings, the participants assumed the role of each other. For instance, CG1 and CG2 on the first week of the experimental period will be EG1 and EG2 on the second and third week, and EG1 and EG2 on the first two weeks will be the CG1 and CG2 respectively. Through this method, all participants will have a fair chance to receive lessons aided with microlearning strategy. The study aimed to evaluate whether microlearning improves students' retention compared to the conventional TSIS teaching method. The data were analyzed through One-Way ANOVA. The outcome of the analyses helped assess the effectiveness of microlearning in improving science retention and may inform future curriculum development and program enhancement. Ethical considerations, including informed consent from parents and maintaining student confidentiality, were strictly followed throughout the study. The outcome of this study may add to the existing knowledge based on preschool science education and may further explore various use of microlearning strategies in preschool settings.

Research Locale

Figure 3. Image of Thai-Singapore International School in Google Maps

The study was conducted at Thai-Singapore International School, 1000 Moo 5 Srinakarin Rd. Samrong Nuea Mueang Samutprakan 10270. It is an international trilingual school in Samutprakan district that offers education from Preschool to Secondary. The school follows a Singaporean Curriculum, ergo, as early as nursery, science is already offered. TSIS has received recognition from the Ministry of Education (MOE) of Thailand and accreditation from ONESQA.

Participants of the Study

The study population included more or less 160 Kindergarten 2 learners enrolled at Thai-Singapore International School. These students were distributed across eight different classes: K2-Caring, Cheerful, Gracious, Harmony, Joyful, Loving, Respectful, and Sincere, with 20 students in each class. The participants represented a diverse group of young learners, each of whom were randomly allocated into four groups (two control, two experimental). The control groups followed TSIS conventional teaching method while, the experimental groups were engaged in science lessons using the microlearning strategy. The diverse nature of the participants allowed for a comprehensive evaluation of the microlearning strategy across a broad student population within the same educational setting. Parental consents were obtained prior to participation to ensure ethical standards are met, and all student data remained confidential throughout the study.

The researcher observed the purposive sampling technique in this experimental study. The researcher purposively chose kindergarten 2 level learners. This was comprised of individual learners who were learning science as part of the curriculum. Since the classes were heterogeneously categorized, the researcher assured the impartiality of the result of this study.

Research Instrument

The key research instrument used in this study was a set of science assessments derived from the textbook The Kindergarten Superbook Science Ages 5 and 6 that were published and distributed by Educational Publishing House Pte Ltd. It was authored by Kimberly Teh and was printed in Singapore. This textbook, which was specifically designed for young learners, offered age-appropriate content that aligned with the science curriculum for kindergarten 2 students. The assessments focused on key science concepts covered in the textbook, including basic scientific principles, vocabulary, and understanding of natural phenomena. These test items were adapted to suit the structure of the study, ensuring they effectively measure the retention of science concepts taught through both microlearning and TSIS conventional lessons. The content from The Kindergarten Superbook Science Ages 5 and 6 provided a solid foundation for evaluating the influence of the teaching strategies on the learners' knowledge retention, offering consistency in content and assessment format across all groups.

Data Gathering Procedure

The research employed data-gathering methods including the methodical delivery of science lessons over three (3) weeks, using two distinct instructional strategies: microlearning and TSIS conventional teaching method. Both approaches were applied across the four participant groups, with each group receiving different instructional methods. The lessons covered various science topics are Heart, Lungs and Where the Food Goes, and Animals: Their food, movement and habitat, which are suitable for kindergarten 2 learners, ensuring that content was appropriate for their developmental level.

The control groups received information dense lessons, in accordance with the suggested topics that were covered based on the TSIS's course outline in a week period. For the experimental groups, microlearning was used, presenting each lesson in short, focused segments, that made room for learners to process the information in bite-sized contents. In 3 weeks of four 30-minute sessions per week, different science concepts were taught to all groups, ensuring that the instructional content remained varied and engaging. Since the participants assumed each other's role in this study, CG1 and CG2 became EG1 and EG2 respectively in the preceding weeks and vice versa. To facilitate a clear comparison of lessons, tables were provided, in how classes were assigned to groups and outlining the topics that will be taught, and the structure of each lesson.

Table A. Class Designation for Four (4) Different Groups

Week Number	Participants			
	K2-Loving and Joyful	K2-Cheerful and Caring	K2-Respectful and Sincere	K2-Gracious and Harmony
9	CG1 (with pre-test)	CG2	EG1 (with pre-test)	EG2
10	EG1 (with pre-test)	EG2		
11			CG1 (with pre-test)	CG2

Table B. Weekly Lesson Plan Comparison Between Classes, Control and Experimental Group

Week Number	K2 Science Lessons			
	K2-Loving and Joyful	K2-Cheerful and Caring	K2-Respectful and Sincere	K2-Gracious and Harmony
9	Heart, Lungs and Where	Heart, Lungs and Where	Heart and Lungs	Heart and Lungs

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	the Food Goes CG1	the Food Goes CG2	EG1	EG2
10	Animals: Their Food and Movement EG1	Animals: Their Food and Movement EG2	Where The Food Goes EG1	Where The Food Goes EG2
11	Animals: Their Habitat EG1	Animals: Their Habitat EG2	Animals: Their Food, Movement and Habitat CG1	Animals: Their Food, Movement and Habitat CG2

The lesson content, based on TSIS conventional teaching methods are commonly content heavy instructional periods. To implement the microlearning strategy effectively, the researcher adapted this existing content by restructuring it into snippets of contents, more focused segments that align with microlearning principles. This ensures that both groups receive instruction on the same concepts, but through different delivery formats. Pre-tests were given to identify if pre-test conditions may affect the post-test results and post-tests were administered as an evaluation to assess the students' retention of the material taught, providing data for comparing the effectiveness of the two strategies in supporting science learning at the preschool level.

Statistical Treatment of Data

In this study, the collected data were examined using descriptive and inferential statistics to evaluate how effectively microlearning enhances science retention in kindergarten 2 learners.

For SOP 1 and 2, descriptive statistics, including mean scores, were used to summarize and compare post-test results of 2 kindergarten learners across the four groups: CG1 (control with pre-test), CG2 (control without pre-test), EG1 (experimental with pre-test), and EG2 (experimental without pre-test).

For SOP 3 and 4, frequency distribution table was utilized to show comparisons of post-test results among groups through identifying students who scored 1-5, 6-10 and 11-15 for the topic Heart, Lungs and Where the Food Goes, and 1-5, 6-10, 11-15, 16-20 and 21-25 for the topic Animals: Their food, movement and habitat. In applying these statistical treatments, the researcher can effectively compare learners’ post-test scores among four groups and measure their retention.

For SOP 5,6 and 7, inferential statistics was applied. One-Way ANOVA served as a statistical tool to analyze the differences in post-test scores between the experimental and control groups.

All statistical analyses were conducted at a 0.05 level of significance. The software adopted to analyze the data was Microsoft Excel. The outcome of these tests will guide conclusions regarding the impact of microlearning in early science education and inform future curriculum enhancements aimed at strengthening learners' retention.

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Ethical Considerations

The researcher observed ethical considerations including the safety of all who were part of this experimental study. Letter of consents were sent and approved by the Thai-Singapore International School's Vice Principals and Deputy Managing Director prior to the conduct of this study. Additionally, a letter to ask permission to use the research instrument was sent. Although students' nicknames were included on the parent consent letter for identification purposes, no real names or personal information were collected, and participants' anonymity within the study was fully preserved. All information collected in the study was kept confidential and its access outside the researcher's knowledge is restricted. No data that could identify individual students or families was shared. Taking part in the study was entirely optional, and students and their parents may decline or withdraw any time without any consequences. Participants' privacy was respected at all times, and all data was collected and handled in a manner that ensured their protection from unauthorized access.

RESULTS

Table 1.1 The number of participants and average score (pre and post-test) of CG1 in the topic Heart, lungs and where the food goes.

GROUP	N	Pre-test scores			Post-test scores		
		Min	Max	Average	Min	Max	Average
CG1 (conventional)	40	1	14	7	1	14	9

Table 1.2 The number of participants and average score (pre and post-test) of CG1 in the topic Animals: Their food, movement and habitat.

GROUP	N	Pre-test scores			Post-test scores		
		Min	Max	Average	Min	Max	Average
CG1 (conventional)	37	10	24	16	6	24	17

Table 1.3 Distribution of test scores (pre and post-test) of CG1 for the topic of Heart, Lungs, and Where the Food Goes.

Test scores	CG1 (conventional)			
	Pre-test		Post-test	
	F	%	F	%
1-5	11	27.5	8	20.0
6-10	23	57.5	20	50.0
11-15	6	15	12	30.0
TOTAL	**40**	**100**	**40**	**100**

F means frequency

Table 1.4. Distribution of test scores (pre and post-test) of CG1 for the topic of Animals: Their food, movement and habitat.

Test scores	CG1 (conventional)			
	Pre-test		Post-test	
	F	%	F	%
1-5	0	0.0	0	0.0
6-10	4	10.8	3	8.1
11-15	16	43.2	8	21.6
16-20	13	35.1	19	51.4
21-25	4	10.8	7	18.9
TOTAL	**37**	**100**	**37**	**100**

F means frequency

Table 2.1 The number of participants and average score (post-test only) of CG2 in the topic Heart, lungs and where the food goes.

GROUP	N	Post-test scores		
		Min	Max	Average
CG2 (conventional)	42	3	14	10

Table 2.2 The number of participants and average score (post-test only) of CG2 in the topic Animals: Their food, movement and habitat.

GROUP	N	Post-test scores		
		Min	Max	Average
CG2 (conventional)	39	9	24	20

Table 2.3. Distribution of test scores (post-test only) of CG2 for the topic of Heart, lungs and where the food goes.

Test scores	CG2 (conventional)	
	Post-test	
	F	%
1-5	3	7.1
6-10	24	57.1
11-15	15	35.7
TOTAL	**42**	**100**

F means frequency

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Table 2.4 Distribution of test scores (post-test only) of CG2 for the topic of Animals: Their food, movement and habitat.

Test scores	CG2 (conventional)	
	Post-test	
	F	%
1-5	0	0.0
6-10	2	5.1
11-15	2	5.1
16-20	16	41.0
21-25	19	48.7
TOTAL	**39**	**100**

F means frequency

Table 3.1. The number of participants and average score (pre and post-test) of EG1 in the topic Heart, lungs and where the food goes.

GROUP	N	Pre-test scores			Post-test scores		
		Min	Max	Average	Min	Max	Average
EG1 (microlearning)	32	1	14	7	2	14	10

Table 3.2 The number of participants and average score (pre and post-test) of EG1 in the topic Animals: Their food, movement and habitat.

GROUP	N	Pre-test scores			Post-test scores		
		Min	Max	Average	Min	Max	Average
EG1 (microlearning)	30	5	24	15	8	24	20

Table 3.3 Distribution of test scores (pre and post-test) of EG1 for the topic of Heart, lungs and where the food goes.

Test scores	EG1 (microlearning)			
	Pre-test		Post-test	
	F	%	F	%
1-5	12	37.5	1	3.1
6-10	17	53.1	19	59.4
11-15	3	9.4	12	37.5
TOTAL	**32**	**100**	**32**	**100**

F means frequency

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Table 3.4 Distribution of test scores (pre and post-test) of EG1 for the topic of Animals: Their food, movement and habitat.

Test scores	EG1 (microlearning)			
	Pre-test		Post-test	
	F	%	F	%
1-5	1	3.3	0	0.0
6-10	3	10.0	1	3.3
11-15	13	43.3	5	16.7
16-20	10	33.3	8	26.7
21-25	3	10.0	16	53.3
TOTAL	**30**	**100**	**30**	**100**

F means frequency

Table 4.1 The number of participants and average score (post-test only) of EG2 in the topic Heart, lungs and where the food goes.

GROUP	N	Post-test scores		
		Min	Max	Average
EG2 (microlearning)	37	3	14	11

Table 4.2 The number of participants and average score (post-test only) of EG2 in the topic Animals: Their food, movement and habitat.

GROUP	N	Post-test scores		
		Min	Max	Average
EG2 (microlearning)	38	11	24	21

Table 4.3 Distribution of test scores (post-test only) of EG2 for the topic of Heart, lungs and where the food goes.

Test scores	EG2 (microlearning)	
	Post-test	
	F	%
1-5	1	2.7
6-10	13	35.1
11-15	23	62.2
TOTAL	**37**	**100**

F means frequency

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Table 4.4 Distribution of test scores (post-test only) of EG2 for the topic of Animals: Their food, movement and habitat.

Test scores	EG2 (microlearning)	
	Post-test	
	F	%
1-5	0	0.0
6-10	0	0.0
11-15	2	5.3
16-20	10	26.3
21-25	26	68.4
TOTAL	**38**	**100**

F means frequency

Table 5. Results on the analysis of variance using one-way ANOVA on the post-test results on a. Heart, lungs and where the food goes and b. Animals: Their food, movement and habitat between the control group with pre-test and experimental group with pre-test. Significant at *p<0.05.*

a.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	24.80625	1	24.80625	2.44889864	0.12211724	3.97777939
Within Groups	709.06875	70	10.1295536			
Total	733.875	71				

b.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	130.304814	1	130.304814	6.74351546	0.01162354	3.98855983
Within Groups	1255.99369	65	19.3229799			
Total	1386.29851	66				

Table 6. Results on the analysis of variance using one-way ANOVA on the post-test results on a. Heart, lungs and where the food goes and b. Animals: Their food, movement and habitat between the control group without the pre-test and experimental group without the pre-test. Significant at *p<0.05.*

a.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	26.6857273	1	26.6857273	3.32397929	0.07215754	3.96509407
Within Groups	618.175032	77	8.02824717			
Total	644.860759	78				

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b.

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	35.8635137	1	35.8635137	2.54416745	0.11490788	3.96847099
Within Groups	1057.2274	75	14.0963653			
Total	1093.09091	76				

Table 7. Results on the analysis of variance using one-way ANOVA on the post-test results on a. Heart, lungs and where the food goes and b. Animals: Their food, movement and habitat between the pre-test-post-test and post-test experimental groups. Significant at *p<0.05.*

a.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	92.19993	3	30.73330881	3.403893434	0.01938315	2.666148776
Within Groups	1327.24378	147	9.028869266			
Total	1419.443709	150				

b.

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	328.3344665	3	109.4448222	6.623783249	0.000323377	2.669256364
Within Groups	2313.221089	140	16.52300778			
Total	2641.555556	143				

Table 8. Microlearning Science Enhancement Program

Title of the Program: "Little Scientists, Big Discoveries"

A Microlearning-Based Science Enhancement Program for Kindergarten 2

I. Rationale

Early childhood learners benefit from short, focused, and engaging learning experiences. Based on research findings, microlearning improves content mastery and post-test performance by presenting lessons in small, manageable segments. This program is designed to enhance science instruction for kindergarten 2 learners through developmentally appropriate microlearning strategies that promote curiosity, retention, and active participation.

II. Program Objectives

At the end of the program, Kindergarten 2 learners will be able to:

1. Demonstrate improved understanding of basic science concepts (living things, non-living things, plants, animals, weather, and the five senses).
2. Show increased engagement and participation during science lessons.
3. Apply learned concepts through simple observations, hands-on tasks, and guided activities.

4. Retain scientific knowledge through repeated exposure to short, focused learning segments.

III. Target Learners

- Kindergarten 2 pupils (ages 5–6)

IV. Program Structure

- **Duration:** 6–8 weeks
- **Session Length:** 5–10 minutes per microlearning lesson
- **Frequency:** 3–4 microlearning sessions per week
- **Mode of Delivery:**
    - Face-to-face classroom instruction
    - Digital support (short videos, interactive slides, songs)

V. Microlearning Components

Each science topic is divided into **small learning units (micro-units)** consisting of:

1. **Micro-Introduction (1–2 minutes)**
    - Short story, picture, or question to activate prior knowledge
2. **Micro-Lesson (3–4 minutes)**
    - Visuals, short video clips, real objects, or teacher demonstration
3. **Micro-Activity (2–3 minutes)**
    - Simple hands-on task, matching game, movement activity, or song
4. **Micro-Check (1 minute)**
    - Oral questions, thumbs-up/down, or picture identification

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VI. Sample Science Topics and Microlearning Activities

Topic 1: Living and Non-Living Things

- **Micro-Lesson:** Show pictures of animals, plants, toys, and rocks
- **Micro-Activity:** Sorting pictures into "Living" and "Non-Living"
- **Assessment:** Oral identification and picture pointing

Topic 2: Parts of a Plant

- **Micro-Lesson:** Short animated video showing plant parts
- **Micro-Activity:** Labeling a plant diagram using cut-outs
- **Assessment:** Naming plant parts orally

Topic 3: Animals and Their Homes

- **Micro-Lesson:** Picture cards of animals and habitats
- **Micro-Activity:** Matching animals to their homes
- **Assessment:** Question-and-answer participation

Topic 4: The Five Senses

- **Micro-Lesson:** Song or chant about the five senses
- **Micro-Activity:** Sensory stations (touch, smell, sound)
- **Assessment:** Identifying which sense is used

Topic 5: Weather

- **Micro-Lesson:** Daily weather chart discussion

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- **Micro-Activity:** Dressing a paper doll for different weather
- **Assessment:** Describing the day's weather

VII. Teaching Strategies

- Use of visuals, songs, and storytelling
- Repetition and reinforcement through short lessons
- Play-based and inquiry-based learning
- Immediate feedback and encouragement
- Integration of movement and sensory activities

VIII. Assessment and Evaluation

Learner Assessment

- Pre-test and post-test (picture-based and oral)
- Observation checklist (participation, understanding, engagement)
- Performance tasks (sorting, matching, identifying)

Program Evaluation

- Comparison of pre-test and post-test scores
- Teacher observation and reflection
- Learner engagement and response rate

IX. Expected Outcomes

- Improved post-test performance in science
- Higher level of content mastery
- Increased learner motivation and attention
- Enhanced classroom interaction and participation

X. Sustainability and Enhancement

- Integration of microlearning into daily lesson plans
- Teacher training on designing microlearning materials
- Development of a digital microlearning resource bank
- Parental involvement through short take-home activities

XI. Proposed Budget

- **Microlearning-Based Science Enhancement Program for Kindergarten 2**

Budget Item	**Description**	**Quantity**	**Estimated Cost (PHP)**
Instructional Materials	Picture cards, flashcards, charts, cut-outs	1 set	₱6,720
Printing & Reproduction	Worksheets, activity sheets, assessment tools	1 lot	₱4,480
Learning Manipulatives	Sorting toys, plant models, sensory items	1 set	₱8,400

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Budget Item	Description	Quantity	Estimated Cost (PHP)
Digital Resources	Short educational videos, interactive slides, animations	1 package	₱5,600
Art & Craft Supplies	Paper, crayons, glue, scissors, coloring materials	1 lot	₱5,040
Science Kits	Simple experiment kits (plants, weather tools)	1 set	₱7,840
Teacher Training Materials	Handouts, guides, microlearning lesson templates	1 lot	₱3,920
Monitoring & Evaluation Tools	Observation checklists, pre-/post-test materials	1 lot	₱2,800
Contingency Fund	Unexpected expenses	—	₱2,800
Total Estimated Budget			**₱47,600**

DISCUSSION

This chapter presents the data gathered during the study and provides a systematic analysis and interpretation of the findings. The results are organized according to the research statements of the problem and are presented using appropriate tables, figures, and statistical tools to ensure clarity and accuracy. Through careful analysis, this chapter explains the patterns, relationships, and significant outcomes revealed by the data, offering meaningful insights that address the research questions and support the overall conclusions of the study.

The number of students participated in the research survey (N), the minimum (Min), maximum (Max), and average scores for each group and topics are shown in Table 1.1. The control groups (conventional method) and experimental groups (microlearning method) were further comprised of two groups: one group took both pre-test and post-tests, while the other group only took the post-test assessment. These two sets of tests were comprised of similar questionnaires, and pre-tests were administered to warm up learners of the potential assessment after the duration of subject lessons and to use as an independent variable to identify if post-test results may have impacted under pre-test conditions.

There were 40 and 42 students in the control group, and 32 and 37 students in the experimental group for the topic of heart, lungs and where the food goes lesson. There were 37 and 39 learners in the control group while 30 and 38 students in the experimental group for the topic of Animals: Their food, movement and habitat.

The test scores distribution on the first science topic (Heart, lungs and where the food goes) taught across the two teaching groups which were presented in Table 4 and Figure 4. Scores were pooled together into three distinct groups: 1–5, 6–10 and 11–15 to better visualize (in a graphical manner) higher concentration or frequencies of obtained results. The test given to evaluate the student’s learning of the second science topic

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(Animals: Their food, movement and habitat), was comprised of 24 items and therefore, test scores were grouped further into five: 1–5, 6–10, 11–15, 16– 20, and 21–25.

Research Question 1: <u>What are the post-test scores of the kindergarten 2 learners in the control group with pre-test?</u>

The following table shows the pre-test and post-test results of CG1. The average score was derived from the raw scores of learners in this group. A score distribution table was used to illustrate the distribution of learners' scores in greater detail.

Table 1.1 shows the pre-test and post-test average score of CG1 in the topic of Heart, Lungs and Where the Food Goes. Pre-test score revealed that learners in this group acquired an average of 7 out of 14. The post-test results of CG1 are in the average of 9, out of 14 as the maximum score.

Table 1.2 presents the pre-test and post-test mean scores of CG1 on the topic Animals: Their Food, Movement, and Habitat. The pre-test results indicate that learners in this group achieved an average score of 16 out of 24. The post-test results show a slight increase, with CG1 obtaining a mean score of 17 out of a maximum of 24.

Table 1.3 presents the distribution of pre-test and post-test scores of CG1 for the first topic. The pre-test results indicate that 27.5% of the learners scored between 1–5 points, the majority (57.5%) obtained scores within the 6–10 range, while 15% achieved scores between 11–15.

In the post-test, the score distribution shows a shift in performance. Most learners (50%) continued to score within the 6–10 range, a smaller proportion moved into the higher 11–15 score bracket, and 20% of the learners remained in the lowest range of 1–5 points.

Table 1.4 presents the distribution of pre-test and post-test scores of CG1 for the second topic. The pre-test results show that none of the learners (0%) scored within the 1–5 range. A small proportion (10.8%) obtained scores between 6–10, while 43.2% of the learners scored within the 11–15 range. Additionally, 35.1% achieved scores between 16–20, and 10.8% scored within the highest range of 21–24.

The post-test score distribution indicates changes in learners' performance. The majority of learners (51.4%) scored between 6–10 points, while 21.6% attained scores in the 11–15 range. No learners (0%) scored within the 1–5 range. A smaller proportion (8.1%) fell within the mid-range category, and 18.9% of the learners achieved scores between 21–24.

The pattern indicates a slight increase in the post-test scores of learners in CG1. However, the improvement is not substantial. Given that the learners were exposed to a cognitively dense lesson, many students may have experienced difficulty in fully grasping the content. The same result is shown in the study by Pack et al. (2023), which indicated that preschool children demonstrated stronger learning outcomes when instructional materials imposed minimal intrinsic cognitive demands, whereas learning performance declined when unnecessary irrelevant information processing demand was incorporated into the materials.

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Research Question 2: **What are the post-test scores of the kindergarten 2 learners in the control group without the pre-test (CG2)?**

The table below presents the post-test results of CG2. The mean score was calculated from the learners' raw scores. Additionally, a score distribution table was provided to offer a detailed overview of how learners' scores were spread across the group.

Table 2.1 presents the post-test scores for the first topic in CG2. The data indicate that learners in CG2 achieved an average score of 10, which is one point higher than the average score of 9 observed in CG1.

Table 2.2 shows that CG2 achieved an average score of 20 on the second topic. This score is 3 points higher than the average score obtained by CG1.

Referring to the score distribution in table 9, the majority of students in CG2 scored between 6 and 10 points, representing 57.1% of the group. Meanwhile, 35.7% of the learners scored within the 11 to 15 points range, and a smaller proportion, 7.1%, scored between 1 and 5 points.

Table 2.4 shows that CG2 exhibited a nearly even distribution of scores, with 41% of students scoring between 16 and 20 points and 49% scoring between 21 and 25 points. The remaining 5.1% of learners scored between 6 and 10 points, and another 5.1% scored between 11 and 15 points.

Comparison of the post-test scores between CG1 and CG2 shows a slight improvement in both groups. Even so, the difference is minimal. The cognitively demanding nature of the lessons likely contributed to the limited gains in learners' performance. Baggini and Ricciardelli (2025) reported that as cognitive load decreased, participants showed better recall of the order of elements in a memory task, suggesting that lower cognitive demands can improve the processing of sequential information in working memory.

Research Question 3: **What are the post-test scores of the kindergarten 2 learners in the experimental group with pre-test (EG1)?**

The following table shows the pre-test and post-test results for EG1. The average score was derived from learners' raw scores, and a score distribution table provides a detailed view of how the scores were distributed across the group.

Experimental group learners (EG1) achieved a pre-test average score of 7 out of 15, which increased to an average of 10 on the post-test, as shown in Table 11. Notably, this post-test average matches the score obtained by CG2 in the first topic, indicating comparable performance between the experimental and conventional groups after instruction.

In comparison, Table 3.2, which presents results for the topic Animals, shows that learners in EG1 achieved a pre-test average of 15 out of 24. Their post-test performance improved to an average score of 20, which is identical to the average score obtained by CG2, indicating that both the experimental and conventional groups reached similar levels of achievement after instruction.

Table 3.3 presents the distribution of students' pre-test scores for the first topic, showing that 9.4% scored 11–15 points, 53.1% scored 6–10 points, and 37.5% scored 1–5 points. In the post-test, learners in EG1 demonstrated a shift toward higher scores,

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with 37.5% of students scoring 11–15 points, 59.4% scoring 6–10 points, and only 3.1% remaining in the 1–5 point range.

Table 3.4 presents the pre-test results of learners in EG1, showing that the largest proportion of students (43.3%) scored between 11–15 points. A smaller percentage (13.3%) scored within the 1–10 point range, while the remaining 43.3% scored between 16–24 points. The post-test results demonstrate a clear shift toward higher scores, with the majority of learners (53.3%) achieving 21–24 points. Fewer students scored in the lower ranges: 1–5 points (0.0%) and 6–10 points (3.3%), while 16.7% and 26.7% of learners scored in the 11–15 and 16–20 point ranges, respectively, indicating a strong overall improvement in performance.

The results indicate that EG1, which underwent microlearning, experienced improved test performance with a marked increase in the number of learners attaining high scores compared to the control groups. This is consistent with the study of Sirwan Mohammed et al. (2018) reported an 18% of the students' learning abilities improved after microlearning instruction.

Research Questions 4: <u>What are the post-test scores of the kindergarten 2 learners in the experimental group without the pre-test (EG2)?</u>

The following tables present the post-test results of EG2. The learners' raw scores were used to derive the mean score, and a score distribution table provides a detailed breakdown of how scores are spread among the participants.

Referring to table 4.1, EG2 learners got an average score of 11 out of 15. Among all groups, EG2 attained the highest average score for the first topic. Although it's the highest score among four groups, the difference is minimal.

On the topic of animals, learners gained and average score of 21 out of 24, a point away from the average scores of CG2 and EG1 (Table 4.2). The post-test score based on the means among all groups showed very minimal differences.

Examination of the test distribution table (Table 4.3) reveals a more detailed contrast of post-test scores across groups. EG2 had the largest percentage of students scoring 11–15 points (62.2%), exceeding the proportion observed in the control group (Tables 5 and 9). Learners scoring in the 1–5 point range were the fewest at 2.7%, while 35.1% of students fell within the 6–10 point range.

Looking at the test distribution of EG2 post-test results (Table 4.4), 68.4% of the learners scored 21–25 points, indicating high mastery of the material. No learners scored within the 1–10 point range, while 5.3% of students scored 11–15 points, and 26.3% achieved scores in the 16–20 point range.

The pattern observed in EG1 was also evident in EG2, with an even greater effect, as this group had the highest concentration of learners achieving high scores. The same results were shown by Simaremare et al. (2025) wherein microlearning model obtained an average of 85 learning outcome compared to the conventional learning approach that only obtained an average of 72. Zulueta and Panoy (2022) reported high satisfaction among students on the use of microlearning strategy which aligns to their learning needs.

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Research Questions 5: Is there a significant difference between the kindergarten 2 learners' post-test scores of the control group with pre-test (CG1) and the post-test scores of the experimental group with pre-test (EG1)?

The analysis of variance for the lesson Heart, Lungs and Where the Food Goes revealed if the results are statistically different among the scores of the control group and experimental group with pre-test (Table 5a). Likewise, the analysis of variance for the lesson Animals: Their food, movement and habitat revealed whether the scores of the control group and the experimental group with pre-test differed statistically, as shown in Table 5b. The pre-test serves as a testing condition that helps determine whether microlearning produces greater learning gains compared with conventional teaching methods.

For the first topic (Heart, Lungs and Where the food goes), the ANOVA results confirm that no significant statistical difference exist between the two groups, as indicated by an F-value of 2.45, falling short of the critical value of 3.98, with a p-value of 0.122, which exceeds 0.05. On the other hand, The ANOVA results for the topic Animals: Their food, movement and habitat demonstrate a statistically significant difference in post-test scores between the control group with a pre-test (CG1) and the experimental group with a pre-test (EG1). The F-value of 6.74 exceeds the critical F-value of 3.99, coupled with the p-value of 0.012 is below the 0.05 threshold.

The significant ANOVA result for the *Animals: Their Food, Movement, and Habitat* topic where EG1 outperformed the CG1 may partly reflect the learning benefit of having engaged in a pre-testing activity. The pre-test likely helped learners activate prior knowledge, focus attention on key concepts before instruction, and build a stronger foundation for the microlearning intervention, producing greater learning gains in the experimental condition. Mera et al. (2025) found that participants who completed pre-tests achieved greater recall accuracy and stronger memory performance on later assessments than those who did not experience a pre-test condition. Their results suggest that even when initial responses were incorrect, the act of attempting retrieval likely engaged memory processes that enhanced encoding of key information, leading to better outcomes than passive study alone.

Research Questions 6: Is there a significant difference between the kindergarten 2 learners' post-test scores of the control group without the pre-test (CG2) and the post-test scores of the experimental group without pre-test (EG2)?

For the lesson Heart, Lungs and Where the Food Goes, the post-test scores of the control group and the experimental group without a pre-test were compared using analysis of variance, as summarized in Table 6a. Similarly, for Animals: Their food, movement and habitat, the ANOVA results indicated differences in post-test performance in the control versus experimental groups without pre-test, presented in Table 6b. By examining these results, it is possible to measure the impact of microlearning in refining learning outcomes compared with traditional instruction, even without the pre-test.

The ANOVA results for the topic Heart, Lungs, and Where the Food Goes comparing the post-test scores of the control group without pre-test (CG2) and the

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experimental group without pre-test (EG2) indicate no statistically significant difference between the groups CG2 and EG2. The F-value of 3.32 is slightly below the critical F-value of 3.97, and the p-value of 0.072 exceeds the 0.05 significance level. Similarly, for the topic Animals: Their food, movement and habitat, the ANOVA results comparing the post-test scores of the control group without pre-test (CG2) and the experimental group without pre-test (EG2) indicate no statistically significant difference between the groups. The F-value of 2.54 is less than the critical F-value of 3.97, along with the p-value of 0.115 is greater than the 0.05 significance level.

EG2 learners achieved a greater portion of the high point range compared to CG2 in both topics. Even so, the difference in post-test scores between the two groups was not statistically significant. This can occur when the intervention helps some learners perform better, but the overall mean difference between groups is small relative to the variation within each group. A similar observation was reported by Padmavathi, Omprakash, and Kumar (2019), where students in the intervention group scored higher on average, yet the difference compared with the control group was not statistically significant, indicating that improvements can occur even if group differences are subtle.

Research Questions 7: <u>Is there a significant difference between the test scores of the kindergarten 2 students in the control group and experimental group?</u>

Statistical differences between the students' performances across test groups (pre-test groups and post-test only groups) were explored through One-Way analysis of variances assuming homogeneity across the test groups. Results are represented in Table 7 for the Heart, lungs and where the food goes and Animals: Their food, movement and habitat science topics, respectively.

The first topic focuses mainly on the body function and processes showing a slight effect of microlearning technique in the post-test outcomes of the two tested groups. Findings from the analysis indicated significant differences ($p<0.05$) between the scores obtained by all four groups (Table 7a). A similar result was also observed for the second topic ($p<0.05$), (Table 7b) highlighting the effectivity of microlearning techniques in teaching science-related subjects. Microlearning provides a balance of evidence-based effectiveness and practical classroom flexibility. Microlearning approach improved comprehension, enhanced retention and provide more meaningful engagement with science content. Young learner's attention span is generally shorter and hence, the utilization of short, small fractions of lessons through microlearning techniques will be suitable to cater the needs of young learners. Short content has shown an improvement in retention of knowledge by 20% conversely the acquired knowledge of students is easily forgotten using the conventional method (Simaremare et al. 2025). The study further reported that after the strategy was enacted, post-test results fall under approaching proficiency and proficient level. Likewise, Calixto (2023) showed an improved academic performance in the Chemistry subject subsequent to interaction with microlearning-aided lessons.

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Research Questions 8: <u>What program can be recommended based on the findings of the study?</u>

Based on the findings, a microlearning-based instructional enhancement program is recommended for teaching science topics to Kindergarten 2 learners. The study highlights that students exposed to microlearning generally achieved higher average post-test scores and demonstrated better mastery of content compared with the control groups. Although certain comparisons, like between the control and experimental groups without pre-tests, showed no statistically significant differences, the overall trend indicates that microlearning supports learning gains and student engagement. Microlearning method is not only applicable to young learners, but it has also been proven effective to higher education students. For example, Hlazunova et al. (2024) reported a better result through microlearning technology as a result of increased student involvement and motivation to learn. Microlearning has been shown to be an impactful learning approach in increasing the nursing students' knowledge gains and perceived self-efficacy (Zarshenas et al. 2022).

The table above outlines the proposed microlearning science enhancement program detailing the content, learning activities, and duration for each segment. The program is designed to deliver science concepts through microlearning techniques, providing learners with short, focused lessons that enhance engagement and knowledge retention. Assessment & Reinforcement component combines post-tests and review activities through objective type tests, matching exercises, and interactive games, allowing learners to consolidate knowledge and demonstrate mastery over the topics.

To ensure the successful delivery of the microlearning program, a budget was allocated for essential training, platforms, assessment tools, and materials. The last part of the program shows a proposed budget supporting the implementation of the microlearning program for content development trainings, covering teacher training, instructional material development, and assessment design.

Therefore, the recommended program should deliver content in short, focused lessons, include interactive activities to reinforce understanding, and employ post-test assessments to monitor progress. It can be implemented alongside conventional instruction, allowing educators to adapt lessons according to students' performance and ensure that all learners benefit, even in cases where improvements are not statistically significant. This approach balances evidence-based effectiveness with practical classroom flexibility, promoting enhanced comprehension and retention of science concepts.

Microlearning is a teaching approach wherein lessons are delivered in small, bite-sized content and learning activities by leveraging digital technologies and interactive presentations through PowerPoint, informative videos, flashcards, audios and podcast and graphic animations Though relatively new, a wide body of studies supports the effectivity of the method in the enhancement of students' motivation, performance, interaction, knowledge retention and concept connection to real-life.

<u>Summary of Findings</u>

1. On the first topic, Control Group 1 (CG1) achievements reflect a clustering around mid-level performance. A portion of learners in CG1 belongs to the higher-

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performing learners. While CG1 demonstrated basic comprehension, mastery of the topic remained limited for several learners. On the other hand, on the topic of animals, CG1 results indicate a notable subset of higher achievers. The distribution reflects moderate improvement in understanding compared to Topic 1, with more learners reaching higher score brackets. The topic appears to have been better grasped overall, possibly due to content familiarity or instructional effects. CG1 demonstrated improved performance on the second topic with a wider spread of higher scores. The findings indicated progress in learning, though with variation in achievement levels across topics.

2. On Topic 1, Control Group 2 (CG2) score distribution showed on the same topic that the majority of the learners scored within the mid-point range and a smaller portion of learners scored within the top point range, indicating fewer high scorers. CG2 demonstrated a slightly stronger performance than CG1 in this topic. The score clustering suggests moderate understanding but limited mastery for many learners. Carrying on, on the topic of animals, CG2 consistently outperformed CG1 on both topics, with higher mean scores and higher score concentrations in the mid to top point range. The learners in CG2 showed better mastery in the second topic supported by the results that showed higher average and a larger share of high-range scores. The performance pattern suggests that CG2 had stronger over-all understanding, especially in the topic of animals.

3. (Experimental Group 1) EG1 post-test results showed very small number of learners in the lower bracket and a large share of students scoring in the higher bracket indicates strong overall understanding after microlearning was incorporated as an teaching strategy. On the topic of animals, the score distribution of EG1 reveals the post-test scores were concentrated in the highest performance range, reflecting strong mastery of the topic. The results indicate improvement in learners learning under the microlearning strategy. EG1 showed consistent strong performance in both areas. Although the average scores tied to CG2, the score distribution showed clear improvement that outstands CG2, especially the lower-range scorers are minimized, and higher-range scorers are maximized. The exposure of the learners in pre-test combined with experimental intervention may have provided higher learning gains.

4. The learners in EG2 obtained the highest mean score among four groups on Topic 1. Although it is the highest average, the difference compared to the other groups is minimal which indicate similar performance level across all groups. However, scores distribution of EG2 in the first topic had the largest portion of learners which surpasses the corresponding percentage in the control groups. This distribution shows a high level of mastery of the lesson after the integration of microlearning. The concentration of learners in the 11-15 points bracket indicates greater depth of understanding compared to the control group. EG2 results shows that learners demonstrated exceptionally strong mastery on the topic of animals. The dominance of high range scores indicates that learners in EG2 not only performed well but reached high level of mastery. Even with very minimal difference between the mean scores across all groups, EG2 had more students achieved scores in the top point bracket. The results imply that the experimental group without the pre-test may have supported a strong learning effect where learners achieved high mastery level.

5. The findings for the first topic reveal that CG1 and EG1 do not differ significantly. This suggests that microlearning intervention with pre-test did not produce significant greater learning gains than the conventional group. On the second topic, difference

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between CG1 and EG1 was found to be statistically significant. The results suggest that microlearning intervention, combined with a pre-test in this specific topic, led to significant higher learning gains compared with conventional teaching. The ANOVA results between two different topics showed contrasting results. These findings may imply that microlearning effects may vary depending on the lesson content. The pre-test conditions likely influenced a marked increase in learners' engagement and performance was seen in the second topic.

6. Across both topics, findings revealed that CG2 and EG2 did not differ in a statistically significant way. The results suggest that microlearning did not lead to significantly higher performance than the conventional instruction when no pre-test was administered.

7. The significant results indicates that microlearning impacted student learning outcomes in both topics. These findings suggest that microlearning is beneficial in enhancing science competencies that leads to better mastery of the lesson and increased retention. Given the trends of increased retention and mastery of the lesson for the experimental groups, it suggested that microlearning is a successful approach to improve retention.

8. Based on the study's findings, evidence suggests that a microlearning-based instructional program is an effective teaching strategy for teaching science topics in kindergarten 2 learners, thus, enhancement program on microlearning is recommended.

Conclusions

1. CG1learners demonstrated progress in learning with stronger performance in the second topic. The score distributions show that more students reached higher performance brackets in Topic 2 than in Topic 1. Although Topic 1 results reflect moderate understanding, Topic 2 outcomes show increased mastery, indicating positive learning development. The variation in achievement levels across topics suggests that content, learner familiarity and instructional factors may influence performance. CG1's results provide evidence of increased learning gains.

2. Learners in CG2 outperformed CG1 across both topics which is reflected in higher mean scores and stronger score distributions. CG2 learners demonstrated better mastery particularly in the second topic since the performance shifted significantly towards higher achievement levels. The results suggest that CG2 had an overall stronger grasp of the science content especially in the animal's lesson. The distribution pattern shows more students achieved the top-range scores. These indicates a positive learning outcome and a solid understanding of key concepts.

3. Consistent strong performance across both topics was exhibited by learners in EG1. While average scores were similar to CG2, the distribution patterns show that learners in EG1 achieved higher-quality learning outcomes. The combination of pre-test and microlearning intervention appears to have contributed to greater learning gains.

4. The strongest performance pattern was exhibited by learners in EG2 among four groups if the score distribution is considered as basis. While average scores were similar across groups, the high concentration of learners in the upper score range sets EG2 apart. These findings suggest that microlearning without a pre-test can still produce high levels of mastery which enabling more learners to reach superior performance levels.

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EG2's results show that microlearning may effectively support deeper understanding and higher achievement even if pre-test conditions are unavailable.

5. The ANOVA results for the two topics revealed different outcomes. The results showed that the effectiveness of microlearning with a pre-test may depend on the lesson content. While Topic1 did not yield significant differences, Topic 2 showed clear statistical evidence of microlearning's positive impact. These findings imply that the pre-test condition likely enhanced learner engagement and comprehension more strongly in Topic 2. To sum up, microlearning paired with pre-test conditions shows topic-specific effectiveness which supports higher learning gain.

6. For both topics, ANOVA results consistently showed no statistically significant differences between CG2 and EG2. These findings indicate that microlearning and conventional compared by group (groups without pre-tests) showed has no difference with its results. Even though EG2 used microlearning and showed high concentration of students who scored at the top-bracket points, both groups received structured instruction. If conventional teaching was effective, the performance gap may have naturally narrowed.

7. The One-Way ANOVA results show statistically significant differences across the test conditions for both science topics. These findings strongly suggest that microlearning is an effective instructional strategy that supports improved student performance, stronger mastery of content and increased retention of science concepts. As with the previous studies, these results further support the idea that the adoption of microlearning strategy greatly affect the learners' achievement levels compared to the traditional or conventional way of teaching. The same results were shown by Simaremare et al. (2025) wherein microlearning model obtained an average of 85 learning outcome compared to the conventional learning approach that only obtained an average of 72. Zulueta and Panoy (2022) reported high satisfaction among students on the use of microlearning strategy which aligns to their learning needs. The study further reported that after the strategy was enacted, post-test results fall under approaching proficiency and proficient level. Likewise, Sirwan Mohammed et al. (2018) reported an 18% of the students' learning abilities improved while Calixto (2023) showed an improved academic performance in the Chemistry subject subsequent to interaction with microlearning-aided lessons.

8. Findings from the study suggest that the use of a microlearning-based instructional program improved the performance of kindergarten 2 learners for teaching science topics. The results from the experimental groups consistently show that microlearning enhance post-test performance, supports mastery and fosters greater student engagement compared with conventional instruction. Microlearning provides a balance of evidence-based effectiveness and practical classroom flexibility. Microlearning approach improved comprehension, enhanced retention and provided more meaningful engagement with science content. Young learners' attention span is generally shorter and hence, the utilization of short, small fractions of lessons through microlearning techniques will be suitable to cater the needs of young learners. motivation to learn. Microlearning has been shown to be an impactful learning approach in increasing the nursing students' knowledge gains.

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Recommendations

1. Since CG1 showed moderate understanding in Topic 1 (Heart, lungs and where the food goes), additional reinforcement activities are recommended to strengthen comprehension. Activities could include visual aids, hands-on experiments or interactive storytelling to make abstract concepts more concrete. The stronger performance in Topic 2 (Animals: Animals: Their food, movement and habitat) indicates that instructional methods content familiarity or engagement strategies used for this topic were effective. Similar approaches like real-life examples, interactive discussion or group activities can be applied to Topic 1 to boost understanding.
2. CG2 learners already demonstrated higher mean scores and strong mastery especially in the second topic. Since this is the case, reinforcement activities should focus on consolidating understanding and preventing knowledge gaps. Activities such as summary or recapping or reflective discussion through asking probing questions can help solidify key concepts. If there are any gaps in lower-performing areas, address it through targeted review sessions or interactive materials. Regular assessment is also recommended.
3. The combination of pre-test and microlearning was effective in producing strong performance across both topics. Future lessons should maintain this approach to maximize engagement, readiness and learning gains. The pre-test results could also be used as baseline to track learner's progress. Pre-tests not only assess prior knowledge but also activate cognitive readiness. It is recommended to use the pre-test results logically to highlight key concepts and guide targeted instruction. Regular monitoring through assessments should be implemented to track progress.
4. The high concentration of learners in the upper score range demonstrates that microlearning can also promote strong mastery and high achievement even without the pre-test conditions. It is recommended to maintain delivering lessons in short, focused and concept-specific segments to maintain engagement and comprehension.
5. The finding suggests that pairing microlearning with a pre-test can enhance engagement and comprehension particularly in topics where learners may need more readiness or prior knowledge activation. Topic-specific effectiveness indicates that microlearning strategies should be tailored according to content difficulty and familiarity.
6. The lack of statistically significance between CG2 and EG2 suggests that well-structured conventional teaching can produce comparable learning outcomes to microlearning when pre-tests are not used. This highlights the importance of lesson organization, clear explanation and guided practice. Although average differences were not significant, EG2 demonstrated a high concentration of learners in the top score bracket. Microlearning can still be utilized strategically to support high achievers. The results shows that pre-tests likely play a role in differentiating learning gains when using microlearning.
7. The statistically significant differences across test conditions indicate that microlearning improves kindergarten 2 learners' retention in science. It is evident through results that showed learners' acquired mastery of content and retention of science concepts. Findings suggest that kindergarten 2 learners benefit from microlearning because learners achieved higher post-test scores and stronger content mastery compared to the conventional way of teaching. Instructions should observe the

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microlearning qualities such as short, focused, concept-specific, interactive and engaging.

8. The findings of this study support using microlearning as an effective teaching strategy for science topics. Microlearning not only improves post-test performance but also helps learners gain a more profound understanding of the content and stay more engaged compared with conventional teaching methods. Its flexibility makes it suitable for young learners with different levels of prior knowledge. Lessons should be short and focused, as young children have shorter attention spans, and brief, targeted content has been shown to improve information retention.

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