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Hands-On Math Kits on Learners' Engagement and Mathematical Proficiency Through Differentiated Instruction

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Abstract**—*The main purpose of this study is to investigate the significant effect of hands-on math kits through differentiated instruction to the learners' mathematical proficiency. This study aims to determine the extent of utilization of hands-on math kits, the level of learners' engagement and mathematical proficiency through differentiated instruction according to learning style. Additionally, it seeks to evaluate the significant difference in the learners' mathematical proficiency using hands-on math kits. Lastly, the significant effect of hands-on math kits through differentiated instruction according to learning style to the mathematical proficiency. A quantitative descriptive research design, particularly an experimental method with both descriptive and inferential components, was employed. The study involved 100 students from Binahaan Integrated School, selected through purposive sampling. Data collection was conducted using standardized and self-made questionnaires. The findings reveal a very high extent of utilization of hands-on math kits across all learning styles, particularly in their interactive and manipulative characteristics. In terms of collaborative and integrative characteristics, visual and kinesthetic learners showed a very high extent of utilization, while auditory and reading/verbal learners showed a high extent of utilization. Behavioral, cognitive, physical, emotional, and social engagement were generally high to very high, with kinesthetic and visual learners demonstrating the strongest engagement across most dimensions. In terms of mathematical proficiency, visual and kinesthetic learners performed excellently, while auditory and reading/verbal learners' performance were identified as very satisfactory. Moreover, a significant difference is found in the mathematical proficiency of the learners in terms of performance tasks, resulting to the rejection of the null hypothesis. This means that learning styles do influence the mathematical proficiency of the learners. Hands-on math kits show significant effect in the mathematical proficiency of visual and kinesthetic learners, leading to the rejection of the null hypothesis. It indicates that hands-on math kits through differentiated instruction are effective in enhancing the mathematical proficiency of these groups. Based on these findings, it is recommended that mathematics teachers may utilize hands-on math kits through differentiated instruction to enhance students' mathematical proficiency. Further research may explore how hands-on math kits can be adapted or combined with other teaching strategies.*

I. INTRODUCTION

The key to learning mathematics effectively is practice, active participation, and a methodical approach to mathematical concepts. Teachers use a variety of techniques, from conventional methods that emphasize procedural fluency to contemporary approaches that emphasize conceptual comprehension and problem-solving abilities. One method that stresses direct interaction with mathematical concepts through investigation, physical manipulation, and real-world applications is hands-on learning in mathematics.

According to Haury and Rillero (2015), the hands-on learning technique engages students in a comprehensive learning experience that improves their critical thinking skills. It can involve activities such as using manipulatives (like blocks or counters) to visualize and understand concepts like fractions or geometry, conducting experiments to explore mathematical patterns and relationships, or solving real-world problems that require mathematical reasoning and calculation. Hands-on learning in mathematics not only makes abstract concepts more concrete and understandable but also fosters learners' engagement and mathematical proficiency.

The connection between a person and her immediate surroundings, including her activities, emotions, and interpersonal interactions, is known as engagement. It occurs during activity, including both observable behavior and mental activity involving attention, effort, cognition, and emotion" (Middleton et al., 2017, p. 667). When a student's actions are focused on performing mathematics, learning mathematics, finishing a mathematical assignment, or otherwise engaging in school mathematics, they are said to be engaged in mathematics. On the other hand, proficiency in mathematics is acquired over time. Students need enough time to engage in activities around a specific mathematical topic if they are to become proficient with it. Learners can have varying levels of engagement and mathematical proficiency. One of the reasons is that they have different learning styles and these learning styles can be catered through differentiated instruction.

Hands-on math kits, through differentiated instruction, can be an effective tool to enhance learners' engagement and mathematical proficiency when incorporated into math lessons. With this in mind, the researcher aims to study the extent to which hands-on math kits are utilized and the level of learners' engagement and mathematical proficiency. The researcher also seeks to determine the effect of hands-on math kits on learners' mathematical proficiency through differentiated instruction.

1.1 Statement of the Problem

1. What is the extent of utilization of Hands-on Math Kits through Differentiated Instruction according to Learning Style in terms of:

1.1 Interactive;
1.2 Manipulative;
1.3 Collaborative; and
1.4 Integrative?

2. What is the level of Learners' Engagement according to Learning Style in terms of:
   2.1 Behavioral;
   2.2 Cognitive;
   2.3 Physical;
   2.4 Emotional; and
   2.5 Social?
3. What is the level of Learner's Mathematical Proficiency according to Learning Style in terms of Performance Task?
4. Is there a significant difference in the learners' mathematical proficiency using hands-on math kits through differentiated instruction according to their learning styles?
5. Is there a significant effect of Hands-on Math Kits through Differentiated Instruction according to Learning Style on the Mathematical Proficiency?

II. METHODOLOGY

2.1 Research Design

The research design used in this study was a quantitative descriptive research design particularly the experimental method with descriptive and inferential components that aims to determine the difference in the learners' mathematical proficiency and the effect of utilizing hands-on math kits to the mathematical proficiency of Grade 8 students according to learning style based on performance tasks. This research method was experimental since it involved collecting data and interpreting it to determine the difference and effect among the variables and the study's desired results.

According to Thomas (2024) experimental designs have higher external and internal validity than most true experiments, because they often involve real-world interventions instead of artificial laboratory settings and they allow researchers to better control for confounding variables than other types of studies do.

2.2 Respondents of the Study

The respondents of this study were three (3) sections composed of one hundred (100) Grade 8 students enrolled in Binahaan Integrated School during the School Year 2024-2025 at Pagbilao Quezon District II. The respondents are categorized into four groups based on their learning style (visual, auditory, reading/verbal, kinesthetic). The sampling design of this study is purposive sampling based on the needs of this study.One hundred four (104) randomly selected student athletes from Cavite State University – Cavite City Campus were assessed and used as respondents of this research.

2.3 Research Instrument

The research instruments used in this study were standardized and self-made questionnaires and performance tasks that experts validated. The standardized questionnaire adapted from VARK (Visual-Auditory-Reading/Verbal-Kinesthetic)-learn (2019) was used to determine the students' learning styles in terms of visual, auditory, reading/verbal and kinesthetic. The self-made questionnaire was used to determine the extent of utilization of hands-on math kits through differentiated instruction in terms of interactive, manipulative, collaborative and integrative and to determine the level of learners' engagement in terms of behavioral, cognitive, physical, emotional and social.

To determine the extent of the utilization of hands-on math kits through differentiated instruction according to learning style, the mean percentage score was computed and interpreted based on the rating scale below.

Point	Range	Verbal Interpretation	Remarks
5	4.21-5.00	Strongly Agree	Very High Extent
4	3.41-4.20	Agree	High Extent
3	2.61-3.40	Neutral	Moderate Extent
2	1.81-2.60	Disagree	Low Extent
1	1.00-1.80	Strongly Disagree	Very Low Extent

To determine the level of learners' engagement according to learning style, the mean percentage score was computed and interpreted based on the rating scale below.

Point	Range	Verbal Interpretation	Remarks
5	4.21-5.00	Strongly Agree	Very High Engagement
4	3.41-4.20	Agree	High Engagement
3	2.61-3.40	Neutral	Moderate Engagement
2	1.81-2.60	Disagree	Low Engagement
1	1.00-1.80	Strongly Disagree	Very Low Engagement

To find the level of learners' mathematical proficiency according to learning style, the mean percentage score of their performance tasks was computed and interpreted based on the rating scale as shown below:

Range	Verbal Interpretation
17.01-20.00	Excellent
13.01-17.00	Very Satisfactory
9.01-13.00	Satisfactory
5.01-9.00	Fairly Satisfactory
1.00-5.00	Needs Improvement

2.4 Statistical Treatment

Mean and standard deviation were used to summarize the central tendencies and spread of scores to provide a clear result of the extent of utilization and the level of learners' engagement and mathematical proficiency. Additionally, One-way Analysis of Variance (ANOVA) was used to find the difference in the learners' mathematical proficiency. Lastly, Regression Analysis was used to find the effectiveness of hands-on math kits to the learners' mathematical proficiency.

3. Results and discussion

This chapter presents, analyzes, and interprets the data gathered that showed a significant difference in the learners' mathematical proficiency using hands-on math kits through differentiated instruction according to their learning styles, and significant effect of Hands-on Math Kits through Differentiated Instruction according to Learning Style to the Learners' Engagement and the Mathematical Proficiency.

Extent of Utilization of Hands-on Math Kits Through Differentiated Instruction

The major findings for the extent of utilization of hands-on math kits through differentiated instruction according to learning style in terms of characteristics such as interactive, manipulative, collaborative and integrative were shown below.

The following table shows the statement, weighted mean, standard deviation, remarks and verbal interpretation.

Table 1 presents the extent of utilization of hands-on math kits through differentiated instruction according to students' learning styles in terms of interactivity.

Visual learners reported a very high extent of utilization of hands-on math kits through differentiated instruction, with a weighted mean of 4.28 and a standard deviation of 0.63. They strongly agreed that the kits made math more interesting ($\bar{x}$ = 4.30), helped them actively participate ($\bar{x}$ = 4.37), and provided immediate feedback ($\bar{x}$ = 4.26). The consistently high scores suggest that visual learners find the kits highly engaging and beneficial for conceptual understanding and classroom interaction.

TABLE 1. *Extent of Utilization of Hands-On Math Kits through Differentiated Instruction According to Learning Style in Terms of Interactive*

STATEMENTS...	***VISUAL***		***AUDITORY***		***READING/VERBAL***		***KINESTHETIC***		***OVERALL***		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	RMK
I find that using hands-on math kits through differentiated instruction makes learning math more interesting and engaging.	4.30	0.61	4.25	0.65	4.42	0.51	4.52	0.62	4.37	0.60	SA
Hands-on math kits allow me to actively participate in math lessons rather than just listening to the teacher.	4.37	0.63	4.21	0.57	4.08	0.29	4.36	0.70	4.26	0.55	SA
When I use hands-on math kits in our performance tasks, I can better understand math concepts through direct interaction.	4.22	0.58	4.25	0.70	4.42	0.51	4.15	0.67	4.26	0.61	SA
I can get immediate feedback from using hands-on math kits when we are given differentiated instruction, which helps me understand if I'm doing the task correctly.	4.26	0.66	4.14	0.65	4.25	0.45	4.18	0.88	4.21	0.66	SA
I am more likely to ask questions and discuss math concepts with my classmates during performance tasks when I use hands-on math kits.	4.26	0.71	4.18	0.61	4.08	0.51	4.24	0.71	4.19	0.64	A
Weighted Mean	*4.28*		*4.21*		*4.25*		*4.24*		*4.25*		
SD	*0.63*		*0.41*		*0.47*		*0.51*		*0.51*		
Verbal Interpretation	*Very High Extent*		*Very High Extent*		*Very High Extent*		*Very High Extent*		*Very High Extent*		

Auditory learners also showed a very high extent of utilization, with a slightly lower weighted mean of 4.21 and a standard deviation of 0.41. They generally strongly agreed with most statements but only agreed ($\bar{x}$ = 4.14) on receiving immediate feedback. Despite slightly lower averages compared to other groups, auditory learners still found the kits significantly helpful, especially in making math lessons more engaging and promoting peer discussion.

Reading/verbal learners demonstrated a very high extent of utilization as well, with a weighted mean of 4.25 and a relatively low standard deviation of 0.47, indicating consistent responses. They rated the effectiveness of hands-on kits particularly high in making math more interesting ($\bar{x}$ = 4.42) and aiding concept understanding ($\bar{x}$ = 4.42). This suggests that while they typically prefer textual input, they still greatly benefit from kinesthetic and interactive methods when paired with differentiated instruction.

Kinesthetic learners had a weighted mean of 4.24 and a standard deviation of 0.51, also indicating a very high extent of utilization. They especially appreciated the engaging nature of hands-on math kits ($\bar{x}$ = 4.52), though their rating for concept understanding ($\bar{x}$ = 4.15) was slightly lower than expected for their learning style. Nevertheless, they strongly affirmed the hands-on math kits' value in enhancing participation and peer interaction during math lessons.

The weighted mean represents the extent of utilization of hands-on math kits through differentiated instruction across different learning styles. The results indicate that visual learners had the highest weighted mean (M = 4.28, SD = 0.63), followed by reading/verbal learners (M = 4.25, SD = 0.47), kinesthetic learners (M = 4.24, SD = 0.51), and auditory learners (M = 4.21, SD = 0.41. The overall weighted mean across all learning styles was 4.25 with a standard deviation of 0.51, leading to a remark of very high extent. This overall finding reflects that, regardless of individual learning styles, students consistently perceived hands-on math kits as highly valuable tools in enhancing interactivity during math lessons through differentiated instruction.

The result implies that students, regardless of their preferred learning modality, perceive hands-on math kits as instrumental in making mathematics more engaging and interactive. Since all mean values fall within the very high extent range, this indicates that students across all learning styles perceive hands-on math kits as significantly beneficial for interactive learning.

Similarly, incorporating hands-on math kits through differentiated instruction based on students' individual learning styles, educators can address diverse learning needs more effectively, promoting engagement and deeper understanding of mathematical concepts. Scholars such as Larbi (2016) and Brahier (2016) have explored the potential of hands-on manipulatives in modelling and comprehending mathematical operations.

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Extent of Utilization of Hands-On Math Kits through Differentiated Instruction According to Learning Style in Terms of Manipulative

Table 2 shows the extent of utilization of hands-on math kits through differentiated instruction according to students' learning styles in terms of manipulative. It includes statements, weighted mean, standard deviations, remarks and verbal interpretations.

Visual learners demonstrated a very high extent of utilization of hands-on math kits in terms of the manipulative aspect, with a weighted mean of 4.36 and a standard deviation of 0.63. They strongly agreed that the kits helped them use their senses to explore mathematical concepts ($\bar{x}$ = 4.44) and visualize relationships between ideas ($\bar{x}$ = 4.38). Their slightly lower agreement ($\bar{x}$ = 4.19) on the ability to manipulate objects physically may reflect a preference for visual rather than tactile interaction, though they still found the approach highly beneficial for understanding abstract concepts.

TABLE 2

STATEMENTS...	VISUAL		AUDITORY		READING/VERBAL		KINESTHETIC		OVERALL		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	RMK
Using hands-on math kits through differentiated instruction helps me explore different ways to understand math concepts using my senses.	**4.44**	**0.58**	**4.29**	**0.46**	**4.25**	**0.62**	**4.58**	**0.50**	**4.39**	**0.54**	**SA**
I can easily see how math concepts relate to one another when I work with hands-on math kits during our performance tasks.	**4.38**	**0.63**	**4.54**	**0.58**	**4.25**	**0.62**	**4.39**	**0.56**	**4.39**	**0.60**	**SA**
When I use hands-on math kits, I can physically manipulate them to explore and understand mathematical relationships.	**4.19**	**0.62**	**4.07**	**0.60**	**4.25**	**0.45**	**4.48**	**0.62**	**4.25**	**0.57**	**SA**
Hands-on math kits allow me to test my ideas and understand why certain math concepts work the way they do.	**4.41**	**0.64**	**4.00**	**0.72**	**4.33**	**0.65**	**4.39**	**0.50**	**4.28**	**0.63**	**SA**
I find that using hands-on math kits through differentiated instruction makes abstract math concepts easier to understand by turning them into something I can touch and move.	**4.37**	**0.69**	**4.21**	**0.69**	**4.17**	**0.58**	**4.58**	**0.61**	**4.33**	**0.79**	**SA**
Weighted Mean	*4.36*		*4.22*		*4.25*		*4.48*		*4.33*		
SD	*0.63*		*0.64*		*0.57*		*0.56*		*0.60*		
Verbal Interpretation	*Very HighExtent*		*Very HighExtent*		*Very HighExtent*		*Very HighExtent*		*Very High Extent*		

Extent of Utilization of Hands-On Math Kits through Differentiated Instruction According to Learning Style in Terms of Manipulative

Auditory learners also showed a very high extent of utilization, with a weighted mean of 4.22 and a standard deviation of 0.64. They gave strong ratings on how the hands-on math kits helped them relate mathematical ideas and use their senses ($\bar{x}$ = 4.54 and 4.29 respectively). However, they were more reserved in their agreement regarding the ability to manipulate objects ($\bar{x}$ = 4.07) and test ideas ($\bar{x}$ = 4.00). Still, they affirmed the hands-on math kits' effectiveness in making math more tangible and understandable.

Reading/verbal learners had a weighted mean of 4.25 and a standard deviation of 0.57, indicating a very high extent of utilization. They strongly agreed on most items, particularly on using the kits to test ideas ($\bar{x}$ = 4.33) and explore relationships ($\bar{x}$ = 4.25), though their agreement was slightly lower ($\bar{x}$ = 4.17) when it came to making abstract concepts more concrete. This suggests that while their learning style is more language-based, they still find value in the kinesthetic and manipulative aspects of hands-on math kits when utilized through differentiated instruction.

Kinesthetic learners reported the highest extent of utilization among all groups, with a weighted mean of 4.48 and a standard deviation of 0.56. They consistently rated all statements highly, particularly emphasizing the benefit of using their senses ($\bar{x}$ = 4.58) and physically manipulating materials ($\bar{x}$ = 4.48) to understand mathematical concepts. Their responses affirm the alignment between their tactile learning preferences and the manipulative nature of hands-on math kits, highlighting the significant positive impact of differentiated instruction tailored to their needs.

The weighted mean represents the extent of utilization of hands-on math kits through differentiated instruction across different learning styles. The results indicate that kinesthetic learners had the highest weighted mean (M = 4.48, SD = 0.56), followed by visual learners (M = 4.36, SD = 0.63), reading/verbal learners (M = 4.25, SD = 0.57), and auditory learners (M = 4.22, SD = 0.64). For the overall results, the weighted mean of 4.33 and a standard deviation of 0.60 indicate a very high extent of utilization across all learning styles. This implies that students across all learning styles perceive hands-on math kits as significantly beneficial for manipulative learning. Additionally, the utilization of hands-on math kits through differentiated instruction supports students in developing understanding of math concepts through tactile, sensory experiences.

In support of this finding, Satsangi et. al (2016), mentioned that hands-on manipulatives invite students to actively participate in the learning process, encouraging them to explore and experiment. Instead of passively absorbing knowledge, this interaction encourages students to develop their own comprehension through direct interaction.

Extent of Utilization of Hands-On Math Kits through Differentiated Instruction According to Learning Style in Terms of Collaborative

Table 3 presents the extent of utilization of hands-on math kits through differentiated instruction according to students' learning styles in terms of collaborative. It includes statements, weighted mean, standard deviations, remarks and verbal interpretation.

TABLE 3. *Extent of Utilization of Hands-On Math Kits through Differentiated Instruction According to Learning Style in Terms of Collaborative*

STATEMENTS…	*VISUAL*		*AUDITORY*		*READING/VERBAL*		*KINESTHETIC*		*OVERALL*		
	x̄	SD	x̄	SD	x̄	SD	x̄	SD	x̄	SD	RMK
Using hands-on math kits through differentiated instruction helps me work better with my classmates in understanding math concepts.	4.37	0.63	3.89	0.57	4.25	0.62	4.39	0.50	4.39	0.54	SA
When we use hands-on math kits in class, I find it easier to discuss with my classmates and share ideas because we are instructed according to our learning style.	4.26	0.59	4.14	0.65	4.08	0.51	4.39	0.66	4.39	0.60	SA
I feel that working with hands-on math kits through differentiated instruction encourages teamwork and cooperation in math class.	4.22	0.58	4.11	0.69	4.08	0.79	4.09	0.68	4.25	0.57	SA
I feel more comfortable sharing my strategies in Math with my classmates when we are using hands-on math kits through differentiated instruction.	4.22	0.58	3.71	0.71	4.17	0.39	4.36	0.60	4.28	0.63	SA
When we use hands-on math kits in our performance tasks, I can learn different ways of thinking about Math from my classmates.	4.30	0.61	4.04	0.58	3.67	0.49	4.39	0.62	4.33	0.79	SA
Weighted Mean	*4.29*		*3.98*		*4.08*		*4.33*		*4.33*		
SD	*0.56*		*0.65*		*0.59*		*0.62*		*0.60*		
Verbal Interpretation	*Very HighExtent*		*High Extent*		*High Extent*		*Very HighExtent*		*Very High Extent*		

Visual learners reported a very high extent of utilization of hands-on math kits through differentiated instruction in terms of collaboration, with a weighted mean of 4.29 and a standard deviation of 0.56. They strongly agreed across all statements, especially in recognizing that the kits enhance teamwork ($\bar{x}$ = 4.22–4.37) and encourage the sharing of strategies ($\bar{x}$ = 4.22). These results indicate that visual learners perceive collaborative activities involving hands-on math kits as beneficial to their understanding and interaction in math class.

Auditory learners showed a high extent of utilization, with a weighted mean of 3.98 and a standard deviation of 0.65. While they agreed with the positive impact of hands-on math kits on collaboration, their responses were generally less strong compared to other groups. They expressed moderate agreement regarding comfort in sharing strategies ($\bar{x}$ = 3.71) and learning from peers ($\bar{x}$ = 4.04). These findings suggest that although auditory learners find value in collaborative settings, their preference for auditory input may influence their engagement with physically manipulative tools.

Reading/verbal learners also reported a high extent of utilization, with a weighted mean of 4.08 and a standard deviation of 0.59. Their highest ratings were in working better with classmates ($\bar{x}$ = 4.25) and feeling comfortable

sharing strategies ($\bar{x}$ = 4.17). However, they showed lower agreement with learning from classmates during tasks ($\bar{x}$ = 3.67), possibly reflecting a preference for independent or text-based learning over peer discussion. Overall, they acknowledged the benefits of collaboration but may engage more selectively in such settings.

Kinesthetic learners demonstrated the highest engagement in collaborative activities, with a very high extent of utilization (weighted mean = 4.33, SD = 0.62). They strongly agreed with all statements, particularly on the ease of discussing ideas ($\bar{x}$ = 4.39) and the ability to learn from classmates ($\bar{x}$ = 4.39). Their responses align with their learning preference for active, hands-on participation, indicating that collaborative tasks using manipulatives are highly effective for this group.

The results indicate that kinesthetic learners had the highest weighted mean ($\bar{x}$ =4.33, SD = 0.62), followed by visual learners ($\bar{x}$ = 4.29, SD = 0.56), reading/verbal learners ($\bar{x}$ = 4.08, SD = 0.59), and auditory learners ($\bar{x}$ = 3.98, SD = 0.65. The results reveal that the use of hands-on math kits through differentiated instruction is perceived to support collaborative learning to a very high extent by visual and kinesthetic learners, and to a high extent by auditory and reading/verbal learners. Visual and kinesthetic learners reported strong agreement across all indicators, suggesting that collaborative tasks using manipulatives align well with their preferred learning modalities. In contrast, auditory and reading/verbal learners acknowledged the collaborative benefits but with more moderate responses, indicating that while they still find value in peer interaction, their engagement may be influenced by preferences for verbal and auditory processing. For the overall results, the weighted mean of 4.33 and a standard deviation of 0.60 show a very high extent of utilization across all groups. This suggests that, overall, students strongly perceived hands-on math kits as beneficial for enhancing collaboration and teamwork in math learning through differentiated instruction.

This observation is reinforced by previous research of Von Stumm et.al (2015), in which he stated that, when hands-on learning instruction is integrated into the process of learning, learners can interact with one another, share experiences, reduce the fear of trying and develop the inner drive (curiosity) to learning and exploration.

Table 4 presents the extent of utilization of hands-on math kits through differentiated instruction according to students' learning styles in terms of integrative. It includes statements, weighted mean, standard deviations, remarks and verbal interpretation.

TABLE 4. *Extent of Utilization of Hands-On Math Kits through Differentiated Instruction According to Learning Style in Terms of Integrative*

STATEMENTS…	*VISUAL*		*AUDITORY*		*READING/VERBAL*		*KINESTHETIC*		*OVERALL*		
	x̄	SD	x̄	SD	x̄	SD	x̄	SD	x̄	SD	RMK
Using hands-on math kits through differentiated instruction helps me see how different math concepts are connected with each other.	4.37	0.63	4.14	0.76	4.33	0.78	4.58	0.61	4.36	0.70	SA
Using hands-on math kits in our performance tasks allow me to understand how math is applied in real-world situations.	3.96	0.59	4.32	0.67	4.58	0.51	4.52	0.57	4.35	0.59	SA
Using hands-on math kits through differentiated instruction aid in making connections between mathematics and other subjects like science or arts.	4.04	0.65	4.00	0.72	4.25	0.87	4.18	0.58	4.12	0.71	A
Using hands-on math kits through differentiated instruction helps me think critically and apply math concepts to solve real-life problems.	4.07	0.73	4.25	0.65	4.33	0.78	4.61	0.61	4.32	0.69	SA
I think using hands-on math kits through differentiated instruction helps me comprehend how math is connected to other areas of knowledge.	4.26	0.71	4.18	0.61	4.33	0.65	4.45	0.67	4.31	0.66	SA
Weighted Mean	*4.14*		*4.18*		*4.37*		*4.24*		*4.23*		
SD	*0.67*		*0.68*		*0.71*		*0.62*		*0.67*		
Verbal Interpretation	*High Extent*		*High Extent*		*Very High Extent*		*Very HighExtent*		*Very High Extent*		

Visual learners reported a high extent of utilization of hands-on math kits through differentiated instruction in terms of integrative learning, with a weighted mean of 4.14 and a standard deviation of 0.67. While they strongly agreed that hands-on math kits help in seeing connections between math concepts ($\bar{x}$ = 4.37) and understanding broader knowledge integration ($\bar{x}$ = 4.26), their agreement was lower when it came to real-world application ($\bar{x}$ = 3.96) and interdisciplinary connections ($\bar{x}$ = 4.04). These results suggest that while visual learners benefit from conceptual integration, they may be less responsive to applied or cross-subject elements.

Auditory learners also demonstrated a high extent of utilization, with a weighted mean of 4.18 and a standard deviation of 0.68. They showed consistent agreement across all statements, particularly noting the value of hands-on kits in applying math to real-world situations ($\bar{x}$ = 4.32) and critical thinking ($\bar{x}$ = 4.25). Although their scores were slightly lower for interdisciplinary connections ($\bar{x}$ = 4.00), these learners appear to find integrative instruction using hands-on kits effective.

Reading/verbal learners reported a very high extent of utilization, with a weighted mean of 4.37 and a standard deviation of 0.71. They expressed strong agreement across most statements, especially in understanding real-world applications ($\bar{x}$ = 4.58), critical thinking ($\bar{x}$ = 4.33), and interdisciplinary relevance ($\bar{x}$ = 4.25). These results indicate that this group finds differentiated instruction through hands-on kits to be highly effective in supporting integration of mathematical concepts with broader learning contexts and practical applications.

Kinesthetic learners also indicated a very high extent of utilization, with a weighted mean of 4.24 and a standard deviation of 0.62. Their highest ratings were for the application of math in real-life contexts ($\bar{x}$ = 4.52) and using critical thinking to solve problems ($\bar{x}$ = 4.61). They also agreed strongly with statements about conceptual connections ($\bar{x}$ = 4.58) and interdisciplinary understanding ($\bar{x}$ = 4.45). These results align with their preference for active, experiential learning, showing that kinesthetic learners respond well to integrative approaches using tangible materials.

The weighted mean represents the overall extent of utilization of hands-on math kits through differentiated instruction across different learning styles. Reading/verbal learners had the highest weighted mean (M = 4.37, SD = 0.71), followed by kinesthetic learners (M = 4.24, SD = 0.62), auditory learners (M = 4.18, SD = 0.68), and visual learners (M = 4.14, SD = 0.67). These results indicate that hands-on math kits, when used through differentiated instruction, support integrative learning, with reading/verbal and kinesthetic learners reporting a very high extent of utilization. These groups valued the hands-on math kits' role in connecting math to real-world applications and other subject areas. Visual and auditory learners also recognized the benefits, though to a slightly lesser degree, particularly in interdisciplinary and applied contexts. For the overall results, the weighted mean of 4.23 and a standard deviation of 0.67 show a very high extent of utilization across all learning styles. This overall finding suggests that, regardless of preferred learning style, students recognized the effectiveness of hands-on math kits in helping them integrate mathematical knowledge with other subjects and real-world applications.

Concrete manipulatives are beneficial in a wide range of math learning activities, according to Petit (2014). They give practical experience in problem-solving scenarios and sensory information for the development of ideas. They also offer opportunities for students to make connections between related and unrelated ideas, which results in generalizations.

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Level of Learners' Engagement

The major findings for the level of learners' engagement according to learning style in terms of behavioral, cognitive, physical, emotional and social were shown below.

The following table shows the statement, weighted mean, standard deviation, remarks, and verbal interpretation.

Table 5 presents the level of learners' engagement according to learning style in terms of behavioral engagement.

Visual learners demonstrated a high level of behavioral engagement when using hands-on math kits, with a weighted mean of 4.20 and a standard deviation of 0.58. While they strongly agreed that they often volunteer during discussions ($\bar{x}$ = 4.37) and make use of additional learning resources ($\bar{x}$ = 4.22), their ratings for other indicators such as participation in group activities ($\bar{x}$ = 4.15) and completion of performance tasks ($\bar{x}$ = 4.11) were slightly lower, though still positive. These results suggest that visual learners are generally engaged behaviorally but may benefit from more visually-oriented or individually driven activities to maximize their participation.

Auditory learners reported a very high level of behavioral engagement, with a weighted mean of 4.32 and a relatively low standard deviation of 0.46, indicating consistent responses. They showed strong agreement across all statements, particularly in volunteering during discussions ($\bar{x}$ = 4.50), asking questions ($\bar{x}$ = 4.25), and utilizing additional resources ($\bar{x}$ = 4.32). This suggests that auditory learners are highly responsive to instruction that encourages verbal interaction and discussion, which aligns well with their learning preferences.

TABLE 5. *Level of Learners' Engagement According to Learning Style in Terms of Behavioral*

STATEMENTS…	*VISUAL*		*AUDITORY*		*READING/VERBAL*		*KINESTHETIC*		*OVERALL*		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	RMK
When we use hands-on math kits in our lessons, I often volunteer to solve problems or explain concepts during discussion.	4.37	0.63	4.50	0.51	4.33	0.78	4.25	0.62	4.36	0.64	SA
I actively participate in Math group activities and discussions that allows us to use hands-on math kits through differentiated instruction.	4.15	0.53	4.25	0.65	4.58	0.51	4.25	0.62	4.31	0.58	SA
I always complete the performance tasks given by the teacher using hands-on math kits.	4.11	0.64	4.29	0.66	4.25	0.87	4.33	0.49	4.25	0.67	SA
I ask my teacher relevant questions about our lessons while we are using hands-on math kits.	4.15	0.53	4.25	0.65	4.33	0.78	4.25	0.45	4.25	0.60	SA
I take advantage of available learning resources other than what my teacher has provided.	4.22	0.58	4.32	0.72	4.33	0.65	4.25	0.87	4.28	0.71	SA
Weighted Mean	*4.20*		*4.32*		*4.27*		*4.30*		*4.27*		
SD	*0.58*		*0.46*		*0.61*		*0.48*		*0.53*		
Verbal Interpretation	*High Engagement*		*Very HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		*Very High Engagement*		

Reading/verbal learners also demonstrated very high behavioral engagement, with a weighted mean of 4.27 and a standard deviation of 0.61. They strongly agreed with most indicators, particularly in completing tasks ($\bar{x}$ = 4.33) and asking relevant questions ($\bar{x}$ = 4.25), suggesting active and independent learning behaviors. These learners appear to engage well when provided with structured opportunities for expression and reflection, consistent with their strength in verbal and written communication.

Kinesthetic learners displayed a very high level of behavioral engagement, with a weighted mean of 4.30 and a standard deviation of 0.48. They consistently rated all statements highly, with the highest agreement in volunteering during discussions and active participation in group tasks ($\bar{x}$ = 4.33). These findings reflect their preference for movement and physical interaction, indicating that hands-on activities effectively sustain their behavioral involvement in math learning.

The weighted mean represents the level of behavioral engagement across different learning styles. Auditory learners had the highest weighted mean (M = 4.32, SD = 0.46), followed by kinesthetic learners (M = 4.30, SD = 0.48), reading/verbal learners (M = 4.27, SD = 0.61), and visual learners (M = 4.20, SD = 0.58). These findings indicate that the use of hands-on math kits through differentiated instruction promotes high to very high levels of behavioral engagement across all learning styles, with auditory, reading/verbal, and kinesthetic learners exhibiting particularly strong involvement. These groups consistently reported active participation, task completion, and initiative in using additional resources. While visual learners also demonstrated high engagement, their slightly lower ratings on some indicators suggest potential benefits from further tailoring strategies to enhance their active involvement. For the overall results, the mean of 4.27 and a standard deviation of 0.53 show a very high level of behavioral engagement across all groups. This suggests that, in general, students across different learning styles exhibited active participation and consistent involvement when engaged with hands-on math kits. A student is engaged in mathematics if their actions involve doing mathematics, studying mathematics, finishing a mathematical assignment, or otherwise engaging in school mathematics. Middleton et al. (2017, p. 667) describe engagement as taking place during action, encompassing both visible behavior and mental activity that includes attention, effort, thought, and emotion.

Behavior engagement is extensively studied in the area of student engagement. Baldwin (2019) identified a setting in

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which kids would be more engaged if they were allowed to exhibit learning-oriented behavior. Behaviors like socializing and responding to events were classified as learning-oriented.

Level of Learners' Engagement According to Learning Style in Terms of Cognitive

Table 6 reveals the level of learners' engagement according to learning style in terms of cognitive engagement. It includes statements, weighted mean, standard deviations, remarks and verbal interpretation.

Visual learners demonstrated a very high level of cognitive engagement when using hands-on math kits, with a weighted mean of 4.31 and a standard deviation of 0.64. They strongly agreed that they could explain their process ($\bar{x}$ = 4.48), relate math to real-life situations ($\bar{x}$ = 4.37), and enjoy critical thinking tasks ($\bar{x}$ = 4.37). These findings suggest that visual learners effectively engage with mathematical concepts when provided with visually and practically stimulating materials that promote reflection and analysis

TABLE 6. *Level of Learners' Engagement According to Learning Style in Terms of Cognitive*

STATEMENTS…	***VISUAL***		***AUDITORY***		***READING/VERBAL***		***KINESTHETIC***		***OVERALL***		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$
I can explain the steps I take to accomplish the performance task with the use of hands-on math kits.	4.48	0.70	4.32	0.61	4.67	0.65	4.06	0.61	4.38	0.64	SA
I relate Math concepts to real-life situations through the use of hands-on math kits.	4.37	0.49	4.18	0.61	4.42	0.51	4.15	0.71	4.28	0.58	SA
I enjoy doing challenging Math performance tasks that require critical thinking when we are using hands-on math kits through differentiated instruction.	4.37	0.56	4.14	0.65	4.25	0.75	4.24	0.44	4.25	0.60	SA
After using hands-on math kits, I still find myself thinking about what I'm learning in class even when I'm not in class.	4.19	0.74	4.18	0.61	4.25	0.45	4.18	0.73	4.20	0.63	A
I form a new understanding from various pieces of information when we use hands on math kits in our class.	4.15	0.66	4.00	0.72	4.25	0.62	4.30	0.64	4.18	0.66	A
Weighted Mean	*4.31*		*4.16*		*4.37*		*4.19*		*4.26*		
SD	*0.64*		*0.64*		*0.61*		*0.63*		*0.63*		
Verbal Interpretation	*Very HighEngagement*		*HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		*Very High Engagement*		

Auditory learners showed a high level of cognitive engagement, with a mean of 4.16 and a standard deviation of 0.64. While they agreed with all statements, their responses were slightly lower compared to other groups, particularly in forming new understandings ($\bar{x}$ = 4.00) and relating concepts to real life ($\bar{x}$ = 4.18). This may reflect a need for more verbally driven reflection or collaborative processing. Nonetheless, their positive responses indicate that hands-on math kits still support meaningful cognitive involvement for auditory learners.

Reading/verbal learners reported the highest level of cognitive engagement, with a weighted mean of 4.37 and a standard deviation of 0.61. They showed strong agreement across all indicators, particularly in explaining task steps ($\bar{x}$ = 4.67) and forming new understandings ($\bar{x}$ = 4.25). These results indicate that hands-on math kits through differentiated instruction are highly effective for supporting this group's analytical and reflective thinking.

Kinesthetic learners also demonstrated a very high level of cognitive engagement, with a weighted mean of 4.19 and a standard deviation of 0.63. They agreed and strongly agreed with all statements, showing particular strength in forming new understandings ($\bar{x}$ = 4.30) and engaging in critical thinking tasks ($\bar{x}$ = 4.24). Although their self-reported ability to explain steps was slightly lower ($\bar{x}$ = 4.06), these learners clearly benefit cognitively from physically interactive and hands-on tasks that allow them to explore concepts experientially.

The weighted mean represents the level of cognitive engagement across different learning styles. Reading/Verbal learners had the highest weighted mean (M = 4.37, SD = 0.61), followed by visual learners (M = 4.31, SD = 0.64), kinesthetic learners (M = 4.19, SD = 0.63), and auditory learners (M = 4.16, SD = 0.64). For the overall results**,** the weighted mean of 4.26 and a standard deviation of 0.63 show a very high level of cognitive engagement across all learners. This suggests that, in general, students actively engaged their thinking skills when interacting with hands-on math kits during differentiated instruction. The findings highlight the effectiveness of hands-on, differentiated strategies in promoting deep thinking and meaningful learning among diverse learners.

Lots and Holden (2015) mentioned that cognitive engagement is related to an internal psychological process, which also refers to a strategic learning approach that promotes self-regulated deep learning strategies, with higher-order thinking skills, with frequent and interactive engagement.

Level of Learners' Engagement According to Learning Style in Terms of Physical

Table 7 presents the level of learners' engagement according to learning style in terms of physical engagement. It includes statements, weighted mean, standard deviations, remarks and verbal interpretation.

Visual learners demonstrated a very high level of physical engagement, with a weighted mean of 4.41 and a standard deviation of 0.53. They strongly agreed that using hands-on math kits helps them become more involved ($\bar{x}$ = 4.44), stay focused ($\bar{x}$ = 4.26), and feel physically engaged in the learning process ($\bar{x}$ = 4.56). These results suggest that visual learners benefit not only from the visual aspects of manipulatives but also from their interactive, physical components, which enhance their attention and participation in lessons.

Auditory learners also showed a very high level of physical engagement, with a weighted mean of 4.31 and a standard deviation of 0.61. They reported strong agreement with statements involving enjoyment of movement ($\bar{x}$ = 4.43) and feeling physically involved ($\bar{x}$ = 4.39), although slightly lower agreement was noted in focus-related aspects ($\bar{x}$ = 4.18). This indicates that while auditory learners may not primarily rely on physical interaction, they still respond positively to the dynamic and movement-based elements of hands-on learning when aligned with differentiated instruction.

TABLE 7. *Level of Learners' Engagement According to Learning Style in Terms of Physical*

STATEMENTS…	*VISUAL*		*AUDITORY*		*READING/VERBAL*		*KINESTHETIC*		*OVERALL*		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	RMK
I become more active and involved in the learning process when we are hands-on math kits through differentiated instruction.	4.44	0.51	4.18	0.67	4.25	0.62	4.52	0.62	4.35	0.61	SA
I enjoy moving around and using my hands to explore math concepts with physical materials.	4.44	0.58	4.43	0.57	4.50	0.52	4.64	0.49	4.50	0.54	SA
When I use hands-on math kits according to my learning style, I feel like I am physically participating in the lesson, not just sitting and listening.	4.56	0.51	4.39	0.57	4.00	0.43	4.58	0.50	4.38	0.50	SA
Working with hands-on math kits helps me stay focused and attentive during math class.	4.26	0.59	4.18	0.62	4.25	0.62	4.64	0.49	4.33	0.58	SA
I find that using hands-on math kits through differentiated instruction makes learning math feel more dynamic and energetic.	4.44	0.51	4.39	0.63	4.42	0.51	4.79	0.45	4.51	0.53	SA
Weighted Mean	*4.41*		*4.31*		*4.30*		*4.62*		*4.41*		
SD	*0.53*		*0.61*		*0.56*		*0.51*		*0.55*		
Verbal Interpretation	*Very HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		

Reading/verbal learners also exhibited a very high level of physical engagement, with a weighted mean of 4.30 and a standard deviation of 0.56. They expressed strong agreement with enjoying movement ($\bar{x}$ = 4.50) and the energetic feel of learning ($\bar{x}$ = 4.42), though their sense of physical participation was rated slightly lower ($\bar{x}$ = 4.00). These findings suggest that this group may benefit from activities that integrate verbal or reflective components to complement the physical experience.

Kinesthetic learners reported the highest very high level of physical engagement among all groups, with a weighted mean of 4.62 and a standard deviation of 0.51. They strongly agreed with all statements, particularly in feeling physically involved ($\bar{x}$ = 4.58), enjoying movement ($\bar{x}$ = 4.64), and experiencing dynamic learning ($\bar{x}$ = 4.79). These responses emphasize that kinesthetic learners thrive in environments where they can move, manipulate objects, and actively participate in their learning.

The weighted mean represents the level of physical engagement across different learning styles. The results indicate that kinesthetic learners had the highest weighted mean (M = 4.62, SD = 0.51), followed by visual learners (M = 4.41, SD = 0.53), auditory learners (M = 4.31, SD = 0.61), and reading/verbal learners (M = 4.30, SD = 0.56). For the overall results, the weighted mean of 4.41 and a standard deviation of 0.55 reveal a very high level of physical engagement across all learners. This implies that, students with various learning styles demonstrate strong physical engagement when using hands-on math kits through differentiated instruction. Moreover, this conveys that the utilization of hands-on math kits through differentiated instruction is highly efficient in enhancing the physical engagement of students.

Pesce (2014) mentioned that physical engagement that involves complex coordination ability and rapid decision-making processes contribute more than any other to the improvement in the subsequent academic performance of students, especially in subjects that involve the use of logic, such as mathematics.

Table 8 presents the level of learners' engagement according to learning style in terms of physical engagement. It includes statements, weighted mean, standard deviation and remarks.

Visual learners exhibited a very high level of emotional engagement, with a weighted mean of 4.27 and a standard deviation of 0.64. They expressed strong agreement across most indicators, especially enjoying collaboration ($\bar{x}$ = 4.37) and feeling fascinated during performance tasks ($\bar{x}$ = 4.30). While their confidence in math assessments was slightly lower ($\bar{x}$ = 4.19), the overall results suggest that visual learners respond positively to emotionally engaging, visually enriched tasks

that involve peer interaction and creative problem-solving.

Auditory learners demonstrated a high level of emotional engagement, with a weighted mean of 4.20 and a standard deviation of 0.64. They strongly agreed that peer interaction helps them understand lessons better ($\bar{x}$ = 4.36), but showed moderate agreement on feelings of excitement (x̄ = 4.11) and confidence (x̄ = 4.14). This indicates that auditory learners benefit emotionally when they are engaged in discussion and verbal collaboration, though their emotional response to hands-on tasks may be less intense than those of learners who prefer more tactile or visual experiences.

TABLE 8. *Level of Learners' Engagement According to Learning Style in Terms of Emotional*

STATEMENTS…	*VISUAL*		*AUDITORY*		*READING/VERBAL*		*KINESTHETIC*		*OVERALL*		
	x̄	SD	x̄	SD	x̄	SD	x̄	SD	x̄	SD	RMK
I feel excited about the performance tasks that we do in the classroom when we use hands-on math kits through differentiated instruction.	**4.26**	0.66	4.11	0.57	4.00	0.51	4.55	0.51	4.23	0.56	SA
I feel that the interaction with my classmates while using hands-on math kits helps me to understand the lesson better.	**4.22**	0.58	4.36	0.62	4.50	0.52	4.48	0.51	4.39	0.56	SA
I feel fascinated while doing our performance tasks using hands-on math kits through differentiated instruction.	**4.30**	0.67	4.21	0.69	4.17	0.58	4.39	0.61	4.27	0.64	SA
I feel confident when taking Math quizzes and tests after using hands-on math kits through differentiated instruction.	**4.19**	0.68	4.14	0.76	3.83	0.83	4.27	0.57	4.11	0.71	A
I enjoy collaborating with my classmates while using hands-on math kits when we are grouped according to our learning style.	**4.37**	0.63	4.18	0.67	4.08	0.51	4.21	0.74	4.21	0.64	SA
Weighted Mean	*4.27*		*4.20*		*4.12*		*4.38*		*4.24*		
SD	*0.64*		*0.64*		*0.61*		*0.60*		*0.62*		
Verbal Interpretation	*Very HighEngagement*		*HighEngagement*		*HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		

Reading/verbal learners also displayed a high level of emotional engagement, with a weighted mean of 4.12 and a standard deviation of 0.61. They showed strong agreement in understanding lessons through interaction (x̄ = 4.50), but somewhat lower levels of excitement (x̄ = 4.00) and confidence (x̄ = 3.83) in math assessments. These results suggest that while reading/verbal learners benefit emotionally from structured peer interaction, their engagement may be enhanced further through reflective or text-based

Kinesthetic learners showed a very high level of emotional engagement, with a weighted mean of 4.38 and a standard deviation of 0.60. They strongly agreed with all statements, particularly feeling excited (x̄ = 4.55), confident (x̄ = 4.27), and engaged in peer collaboration (x̄ = 4.21). These results clearly align with their learning preferences, as hands-on activities that involve movement and teamwork contribute to a highly positive emotional learning experience for this group.

The weighted mean represents the level of emotional engagement across different learning styles. The results indicate that kinesthetic learners had the highest weighted mean (M = 4.38, SD = 0.60), followed by visual learners (M = 4.27, SD = 0.64), auditory learners (M = 4.20, SD = 0.64), and reading/verbal learners (M = 4.12, SD = 0.61). These findings indicate that the use of hands-on math kits through differentiated instruction effectively fosters emotional engagement across all learning styles, with visual and kinesthetic learners exhibiting very high levels of engagement. These groups reported strong feelings of excitement, fascination, and confidence, particularly in collaborative and interactive settings. Auditory and reading/verbal learners also demonstrated high emotional engagement, especially in peer-related interactions, though their responses were slightly more moderate in areas such as excitement and confidence. For the overall results, the weighted mean of 4.24 and a standard deviation of 0.62 reveal a very high level of emotional engagement across all learning styles. This suggests that hands-on math kits were effective in fostering positive emotions such as excitement, fascination, and collaboration among the majority of students.

In the study of Geertshuis (2019), he revealed that engagement plays a vital role in predicting academic achievement. Through behavioral shaping as a mediator, or the impact of the interaction with cognitive engagement on learning achievement, emotional engagement has an impact on academic performance.

Level of Learners' Engagement According to Learning Style in Terms of Social

Table 9 presents the level of learners' engagement according to learning style in terms of social engagement. It includes statements, weighted mean, standard deviations, remarks and verbal interpretation.

Visual learners demonstrated a high level of social engagement when using hands-on math kits, with a weighted mean of 4.16 and a standard deviation of 0.60. While they agreed that the kits helped them communicate, collaborate, and feel comfortable contributing ideas, most of their responses remained within the "agree" range rather than "strongly agree." This suggests that while visual learners benefit socially from differentiated hands-on tasks, their engagement may be enhanced further with strategies that include more visual collaboration tools or structured peer interactions.

Auditory learners reported a very high level of social engagement, with a weighted mean of 4.24 and a standard deviation of 0.64. They strongly agreed that using hands-on kits encouraged interaction with classmates and teachers, especially in sharing ideas (x̄ = 4.36) and fostering group connection (x̄ = 4.21). These results align well with their preference for verbal communication and collaborative dialogue, indicating that hands-on, differentiated approaches offer effective social learning opportunities for auditory learners.

Reading/verbal learners also showed a very high level of social engagement, with a weighted mean of 4.12 and a standard deviation of 0.58. While most of their responses indicated agreement rather than strong agreement, they acknowledged the benefits of hands-on kits in supporting peer communication and collaborative learning. This suggests that although their learning preference leans toward individual, text-based processing, they still value social aspects of hands-on activities when paired with structured instructional support.

TABLE 9

STATEMENTS…	*VISUAL*		*AUDITORY*		*READING/VERBAL*		*KINESTHETIC*		*OVERALL*		
	x̄	SD	x̄	SD	x̄	SD	x̄	SD	x̄	SD	RMK
Using hands-on math kits through differentiated instruction makes it easier for me to talk with my classmates about the task we're doing.	4.19	0.62	4.29	0.66	4.00	0.60	4.52	0.51	4.25	0.60	SA
When we use hands-on math kits through differentiated instruction, I feel more connected to my teacher and classmates because we can work together in doing a task.	3.96	0.59	4.21	0.57	4.17	0.58	4.33	0.60	4.17	0.59	A
Hands-on math kits encourage me to share my ideas and listen to the ideas of my classmates.	4.19	0.68	4.36	0.68	4.17	0.72	4.27	0.45	4.25	0.63	SA
Working with hands-on math kits helps me develop better communication skills with my classmates.	4.26	0.59	4.14	0.59	4.17	0.58	4.55	0.51	4.28	0.57	SA
Hands-on activities in math create an environment where I feel comfortable contributing my ideas and opinions to the group.	4.19	0.48	4.21	0.74	4.08	0.51	4.39	0.50	4.22	0.56	SA
Weighted Mean	*4.16*		*4.24*		*4.12*		*4.41*		*4.23*		
SD	*0.60*		*0.64*		*0.58*		*0.52*		*0.59*		
Verbal Interpretation	*HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		*Very HighEngagement*		*Very High Engagement*		

Level of Learners' Engagement According to Learning Style in Terms of Social

Kinesthetic learners exhibited the highest level of social engagement, with a weighted mean of 4.41 and a standard deviation of 0.52. They strongly agreed across all statements, particularly noting improved communication (x̄ = 4.55) and ease of peer interaction (x̄ = 4.52). These findings affirm that kinesthetic learners thrive in collaborative, movement-based learning environments where social interaction is integrated into hands-on experiences.

The weighted mean represents the overall level of social engagement across different learning styles. Kinesthetic learners had the highest weighted mean (M = 4.41, SD = 0.52), followed by auditory learners (M = 4.24, SD = 0.64), visual learners (M = 4.16, SD = 0.60), and reading/verbal learners (M = 4.12, SD = 0.58). The findings reveal that hands-on math kits through differentiated instruction effectively promote social engagement across all learning styles, with kinesthetic and auditory learners reporting very high levels of engagement. These groups strongly agreed that such activities enhanced communication, collaboration, and comfort in group interactions. Reading/verbal and visual learners also indicated positive social engagement, though to a slightly lesser extent, suggesting that while they benefit from collaborative environments, their engagement may be further enriched through tailored support that aligns with their preferred modes of learning. The overall weighted mean of 4.23 and a standard deviation of 0.59 show a very high level of social engagement across all learning styles. This suggests that, the use of hands-on math kits through differentiated instruction effectively promoted better communication, collaboration, and social interaction among students.

Bergdahl et al. (2020) posits that social engagement incorporates both individual and collective factors and actions as well as process- and product-oriented approaches. Furthermore, it may be stated that promoting social interaction is crucial for education to progress beyond mere information acquisition and toward learning as participation and knowledge development.

Learner's Mathematical Proficiency

The major findings for the level of learner's mathematical proficiency according to learning style in terms of performance task were presented below.

The table below reveals the groups of learners according to their learning style, mean score of each group in performance tasks, standard deviation and corresponding remarks.

Table 10 presents the level of mathematical proficiency of visual, auditory, reading/verbal and kinesthetic learners in terms of performance tasks that were administered using a rubric.

TABLE 10

Group of Learners According to Learning Style	Mean	SD	REMARKS
Visual	17.13	1.84	Excellent
Auditory	16.45	1.55	Very Satisfactory
Reading/Verbal	16.56	1.40	Very Satisfactory
Kinesthetic	17.5	1.79	Excellent

Level of Learners' Mathematical Proficiency in Terms of Performance Task According to Learning Style in

Visual learners achieved an excellent level of mathematical proficiency, with a mean score of 17.13 and a standard deviation of 1.84. Their strong performance aligns with previous findings indicating high levels of engagement—particularly in cognitive, behavioral, and physical aspects—when instruction involves visually rich, hands-on materials. This suggests that visual learners are effectively supported by tasks that incorporate hands-on math kits enabling them to grasp and apply mathematical concepts with confidence.

Auditory learners attained a very satisfactory level of proficiency, with a mean score of 16.45 and a standard deviation of 1.55. While they performed slightly lower than visual and kinesthetic learners, their scores still reflect solid comprehension and skill application. This performance is consistent with earlier interpretations showing that auditory learners engage well when verbal instruction and collaborative discussion accompany hands-on tasks. Integrating more structured oral components could further enhance their performance outcomes.

Reading/verbal learners also achieved a very satisfactory level of proficiency, with a mean score of 16.56 and a standard deviation of 1.40—the lowest variability among the groups. Their performance indicates that, although their learning preference is not naturally aligned with kinesthetic tools, differentiated instruction that includes reading, writing, and verbal processing opportunities can bridge this gap. Their consistent performance suggests that a structured, language-rich learning environment supports their mathematical understanding in hands-on contexts.

Kinesthetic learners scored the highest among all groups, with a mean of 17.5 and a standard deviation of 1.79, reaching an excellent level of mathematical proficiency. This result confirms earlier findings that kinesthetic learners thrive in active, hands-on environments where they can physically manipulate materials. The strong performance across the four tasks underscores the importance of experiential learning strategies in enabling kinesthetic learners to internalize and apply mathematical concepts effectively.

The mean score represents the overall level of mathematical proficiency of visual, auditory, reading/verbal and kinesthetic learners in terms of performance tasks. The results indicate that kinesthetic learners had the highest mean score of 17.5 and a standard deviation of 1.79, and were remarked as Excellent. It is followed by visual learners with a mean score of 17.13 and standard deviation of 1.84 and were also marked as excellent. Next, is the group of reading/verbal learners who got a mean score of 16.56 and standard deviation of 1.40 and were marked as very satisfactory. Lastly, is the group of auditory learners who attained the mean score of 16.45 and a standard deviation of 1.55 and were also marked as very satisfactory. Overall, this implies that learners across different learning styles demonstrated a high level of mathematical proficiency in constructing geometric figures using hands-on math kits.

The development of sound mathematical competence is, in fact, a crucial area for instruction and research, as noted by Phan et al (2017). Mathematical proficiency is more than simply the learning of official mathematics knowledge (e.g., knowing the concept of algebra in detail). Rather, mathematical proficiency includes a student's capacity for reasoning, problem-solving, justification, and application, when necessary.

Test of Significant Difference in the Learners' Mathematical Proficiency using Hands-On Math Kits through Differentiated Instruction According to their Learning Styles

To test the significant difference in the learners' mathematical proficiency using hands-on math kits through differentiated instruction according to their learning styles in terms of performance task, a statistical treatment was performed using Minitab v16 using regression analysis.

Table 11 presents the significant difference in the learners' mathematical proficiency between groups and within groups.

The results of a one-way analysis of variance (ANOVA) indicated a statistically significant difference in learners' mathematical proficiency when using hands-on math kits through differentiated instruction based on their learning styles, $F(3, 96) = 3.34$, $p = .022$, $\eta^2 = .09$.

TABLE 11. *One-Way ANOVA Results for Mathematical Proficiency*

Sources	*SS*	*df*	*MS*	*F*	*P value*	*Eta-sq*
Between Groups	*19.58*	*3.*	*6.53*	*3.34*	*0.022*	*0.09*
Within Groups	*187.36*	*96*	*1.95*			
Total	*206.93*	*99.00*	*2.09*			

The p-value of .022 is below the significance level of .05. This indicates that at least one of the learning style groups exhibited a significantly different level of mathematical proficiency compared to the others. Furthermore, the effect size, as measured by eta squared ($\eta^2 = .09$), indicates that approximately 9% of the variance in mathematical proficiency can be attributed to the learners' learning styles. This represents a small to moderate effect; this implies that while learning styles play an important role in mathematical proficiency, other factors may also contribute to learners' overall performance.

Indeed, the development of sound mathematical competence is a critical area for instruction and study, according to Phan et al (2017). Mathematical competence encompasses more than just learning official mathematics. A student's mathematical competence, on the other hand, includes the ability to reason, solve, justify, and use as necessary.

Corrêa P. D. (2021), mentioned that the tenet of mathematical proficiency connotes a certain level of measurement in progress of cognitive competence. In other words, a student's adequate level of "mathematical proficiency" would be in line with their testimony of the high quality of their "mathematics learning experience." The student's mathematics learning experience is also reflected in their level of mathematical competence.

Test of Significant Effect of Hands-on Math Kits through Differentiated Instruction According to Learning Style on the Mathematical Proficiency

To test the significant effect of hands-on math kits through differentiated instruction according to learning style on the

Mathematical Proficiency in terms of Performance Task, a statistical treatment was performed using Jamovi 2.3.28 using regression analysis.

A regression analysis was conducted to examine the influence of different instructional approaches—Interactive, Manipulative, Collaborative, and Integrative—on students' mathematical proficiency based on their learning styles (Visual, Auditory, Reading/Verbal, and Kinesthetic).

Table 12 presents the significant effect of hands-on math kits through differentiated instruction in the learners' mathematical proficiency in terms of performance task.

TABLE 12. *Summary of Regression Analysis for Mathematical Proficiency in Terms of Performance Task from Hands-on Math Kits through Differentiated Instruction According to Learning Style*

Performance Task (Visual) Predictor Variables	B	SE B	T	p
(Constant)	1.16	0.59	1.99	0.059
Interactive	0.06	0.13	0.45	0.660
Manipulative	0.47	0.22	2.13	0.045*
Collaborative	0.41	0.24	1.70	0.103
Integrative	-0.08	0.18	-0.47	0.643

Note. *R^2 = .677, F(4, 22) = 11.54, p = <.001.* *p < .05, **p < .01, ****p* < .001.*

Performance Task (Auditory) Predictor Variables	B	SE B	T	p
(Constant)	1.28	0.91	1.40	0.174
Interactive	0.41	0.24	1.69	0.104
Manipulative	-0.01	0.22	-0.06	0.949
Collaborative	0.14	0.25	0.56	0.578
Integrative	0.30	0.19	1.58	0.128

Note. *R^2 = .461, F(4, 23) = 4.91, p = .005.* *p < .05, **p < .01, ****p* < .001.*

Performance Task (Reading/Verbal) Predictor Variables	B	SE B	T	p
(Constant)	-0.33	2.42	-0.13	0.897
Interactive	0.05	0.52	0.09	0.930
Manipulative	0.53	0.37	1.40	0.204
Collaborative	0.02	0.51	0.04	0.966
Integrative	0.60	0.23	2.62	0.034*

Note. *R^2 = .584, F(4, 7) = 2.45, p = .142.* *p < .05, **p < .01, ****p* < .001.*

Performance Task (Kinesthetic) Predictor Variables	B	SE B	T	p
(Constant)	1.12	0.82	1.37	0.182
Interactive	0.23	0.10	2.43	0.022*
Manipulative	0.29	0.18	1.64	0.112
Collaborative	0.05	0.19	0.27	0.792
Integrative	0.27	0.16	1.71	0.099

Note. *R^2 = .490, F(4, 28) = 6.73, p = <.001.* *p < .05, **p < .01, ****p* < .001.*

The computed p-values were compared to the significance level at 0.05 to determine the significant effect of hands-on math kits through differentiated instruction in the learners' mathematical proficiency in terms of performance task.

For visual learners, the regression model explained 67.7% of the variance in performance scores (R^2 = .677, F(4, 22) = 11.54, p < .001), indicating a strong model fit. Among the predictor variables, only Manipulative activities had a significant positive effect on performance (B = 0.47, p = 0.045), indicating that visual learners benefit the most from hands-on, tangible learning experiences. Other variables, such as Interactive, Collaborative, and Integrative strategies, did not show significant contributions, implying that these approaches may be less effective for visual learners.

For auditory learners, the regression model accounted for 46.1% of the variance (R^2 = .461, F(4, 23) = 4.91, p = .005), demonstrating moderate explanatory power. However, none of the predictor variables were statistically significant. The highest contributor, Interactive activities (B = 0.41, p = 0.104), approached significance, indicating that verbal engagement might have some effect. Meanwhile, Manipulative, Collaborative, and Integrative activities showed no meaningful influence. This implies that auditory learners might require different instructional strategies beyond the tested variables to maximize their learning outcomes.

For reading/verbal learners, the regression model explained 58.4% of the variance (R^2 = .584, F(4, 7) = 2.45, p = .142), but the overall model was not statistically significant. Among the predictors, only Integrative learning had a significant positive effect on performance (B = 0.60, p = 0.034), indicating that verbal learners benefit from activities that connect multiple concepts and contexts. However, Interactive, Manipulative, and Collaborative strategies did not show significant effects. The non-significance of the model suggests that additional factors beyond the tested instructional methods may be influencing this group's learning.

For kinesthetic learners, the regression model accounted for 49.0% of the variance (R^2 = .490, F(4, 28) = 6.73, p < .001), indicating a relatively strong model fit. Interactive activities had a significant positive effect on performance (B = 0.23, p = 0.022), meaning that kinesthetic learners benefit the most from active, hands-on engagement. Other variables, such as Manipulative, Collaborative, and Integrative approaches, were not statistically significant, though Integrative learning showed a near-significant trend.

Overall, this implies that different instructional strategies have varying effects on students depending on their learning styles. Manipulative activities significantly enhance performance for visual learners, while Integrative learning is particularly effective for reading/verbal learners. Interactive activities play a key role in the success of kinesthetic learners, whereas no significant predictors emerged for auditory learners, indicating the need for alternative approaches for this group. The high R^2 values for visual and kinesthetic learners indicate that hands-on math kits through differentiated instruction are particularly effective for these groups. However, the non-significant results for auditory and reading/verbal learners indicate that additional strategies, such as verbal explanations, structured discussions, or text-based problem-solving, may be needed to support their learning. The results revealed the importance of aligning instructional strategies to different learning preferences to maximize mathematical proficiency.

According to Charles-Ogan and Amadi (2017), mathematics teachers can utilize manipulatives to capture

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students' interest, help them envision what they are doing (explain abstract concepts), and involve them in hands-on activities. Manipulatives have long been acknowledged as valuable mathematical tools for delivering hands-on learning through tangible objects and research has demonstrated that manipulatives have a positive impact on students' learning and mathematical achievement in contrast to the traditional way of mathematics instruction.

Leaders and instructors must methodically incorporate the use of physical and virtual manipulative materials into classroom instruction at all levels in order to improve each student's mathematical proficiency. (NCSM, 2014). This position is based on research supporting the use of manipulative materials in classroom instruction.

III. Conclusion and Recommendation

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

1. There is a significant difference in mathematical proficiency between the learning styles groups in terms of performance tasks using hands-on math kits through differentiated instruction, leading to the rejection of the null hypothesis. This means that learning styles do influence their performance and overall involvement in the learning process.
2. There is a significant effect in the mathematical proficiency of visual and kinesthetic learners, leading to the rejection of the null hypothesis. However, There are no significant predictors emerged for auditory learners, indicating the need for alternative approaches for this group while there is only one significant predictor for reading/verbal learners. This means that hands-on math kits through differentiated instruction have varying effects on students depending on their learning styles. The results also revealed the importance of aligning instructional strategies to different learning preferences to maximize mathematical proficiency.

The following recommendations were made after the findings and drawing of conclusions:

1. Teachers may utilize hands-on math kits to enhance students' engagement and mathematical proficiency through active learning and direct interaction with materials that allow students to build and internalize mathematical concepts. They may also continue to use differentiated instruction, adapting lessons to the diverse learning styles of students. This may involve offering multiple ways to engage with mathematical concepts, such as combining visual aids, hands-on activities, and written materials, ensuring all students have the opportunity to thrive.
2. Students may still engage with hands-on math kits to make learning math more meaningful and interactive. They should try to stay active in both individual and group tasks using these hands-on materials to improve their understanding of math and stay motivated to learn.
3. Future researchers may investigate how hands-on math kits can be used in more diverse learning environments. They may also explore how these tools can be more effective to auditory and reading/verbal learners. They may further investigate additional predictors or instructional strategies for auditory learners and reading/verbal learners and explore the potential for hybrid learning models that integrate various learning styles into a cohesive approach.

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