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Division Local Heritage Theme Matrix in Teaching Conservation of Mechanical Energy for Junior High School Students

Jayvee D. Gruta*[1], Rezy V. Mendaño, PhD[2]
[1]Silanga National High School, Catbalogan City, Samar, Philippines
[2]Samar State University, Catbalogan City, Samar, Philippines
Corresponding Author e-mail: *jayvee.gruta@deped.gov.ph*

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Abstract
Aim: This study examined the effectiveness of the Division Local Heritage Theme Matrix (DLHTM) in teaching the conservation of mechanical energy to Grade 9 students in a public secondary school under the Schools Division of Catbalogan City. Specifically, it compared the pre-test and post-test scores of students taught using the DLHTM with those taught through the traditional method, determined whether the difference was statistically significant, and developed a DLHTM-based lesson plan for Junior High School instruction.
Methodology: A quantitative quasi-experimental design with non-equivalent groups was employed. The control group received traditional instruction, while the experimental group was taught using the DLHTM, a localized and contextualized teaching strategy. A validated 30-item test (reliability coefficient = 0.868) assessed students' conceptual understanding before and after the intervention. Data were analyzed using frequency, mean, standard deviation, the Shapiro–Wilk test, and an independent samples *t*-test.
Results: Students taught using the DLHTM achieved a higher post-test mean score (M = 21.77) than those in the traditional group (M = 18.07). Statistical analysis showed a significant difference in favor of the DLHTM group, $t = -2.865$, $p < .05$, indicating that localized instruction substantially improved understanding of the conservation of mechanical energy.
Conclusion: The DLHTM proved effective in enhancing both comprehension and retention of scientific concepts. The DLHTM-based lesson plan developed through this study offers a practical resource for making physics instruction more relevant, meaningful, and engaging for Junior High School students.
Keywords: *Contextualized Learning, Conservation of Mechanical Energy, Division Local Heritage Theme Matrix, Localized Instruction, Student Engagement*

INTRODUCTION

Science education encompasses various disciplines, with physics holding a significant position within its framework. Physics serves as one of its pillars, explaining the fundamental principles that govern the physical world. It explores how nature works using the language of mathematics and involves the study of universal laws and the behaviors and relationships among a wide range of physical phenomena (Argaw et al., 2016). Significantly, comprehending various phenomena in the physical world hinges on grasping the fundamental concept of energy, along with its mechanisms of transfer and conservation.

The conservation of mechanical energy states that the total mechanical energy in a closed system remains constant if only conservative forces act (Pika, 2017). Pantidos and Givry (2021) introduced a semiotic approach linking mechanical work and heat to real-world objects and events, making energy transfer concepts more relatable. This method improved teaching by connecting theory with concrete experiences. Similarly, Singh et al. (2016) suggested categorizing physics problems by energy principles to enhance student understanding. Despite its fundamental role in explaining motion and machines, the abstract nature of this principle makes it challenging for students without real-world applications.

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Moreover, students often struggle to distinguish between force and energy or heat and temperature. Textbooks sometimes lack clear explanations of energy forms and transfer mechanisms (Givry & Pantidos, 2015). Halilovic et al. (2021) found that misconceptions about the conservation of mechanical energy are common. Understanding energy is essential at all educational levels but remains challenging due to its abstract nature (Eisenkraft et al., 2014). To improve comprehension and engagement, innovative teaching methods are needed for energy concepts and transfer mechanisms, a call that aligns with recent studies promoting more engaging and contextualized approaches in science instruction (Carvajal et al., 2025).

As education becomes increasingly globalized, there is a growing need to tailor teaching methods to the cultural and contextual backgrounds of learners. Li and Wang (2016) found that traditional teaching methods are often ineffective in developing critical thinking skills, highlighting the greater impact of student-centered approaches. Incorporating local heritage themes into curricula has been shown to enhance student engagement and understanding. Contextualization makes scientific concepts more relevant by linking them to students' experiences (DepEd, 2016). De Lara (2017) found that localization helps students integrate science concepts and appreciate the role of science in education. Similarly, Ocariza et al. (2023) and Pangilinan (2025) emphasized the importance of culturally responsive teaching in addressing learning barriers in science for Filipino students.

The integration of local heritage themes into scientific instruction is a promising path for increasing both the relevance and involvement of Junior High School students. Captured in the Division Local Heritage Theme Matrix (DLHTM), the ten different themes—from festivals and dances to tourism and industry—provide a comprehensive framework for contextualizing teachings across various topic areas. A key idea in Junior High School science curriculum, the convergence of the DLHTM with energy conservation concepts, was the particular focus of this study. This approach not only provides students with a more diverse learning experience but also fosters an appreciation for their local heritage.

The DLHTM has been widely implemented in various subjects, including Science, Araling Panlipunan, and MAPEH, through division-wide teacher training and the integration of lesson plans. According to DepEd Catbalogan City reports (2022), at least 15 public schools have used DLHTM in developing localized instructional materials. In 2023, the Division INSET Program included a special session on integrating DLHTM into science instruction, attended by over 120 teachers. Specific applications in science include incorporating local industries and historical landmarks into lessons on energy sources, using the Manaragat Festival to explain kinetic and potential energy through dance movements, and revising at least 10 lesson plans to integrate DLHTM in teaching energy conservation in transportation and industry.

Similarly, in the Schools Division of Catbalogan City, the conservation of mechanical energy remains one of the least learned skills among Grade 9 students. This challenge is also evident in Silanga National High School, where many students have a limited grasp of this concept. This is further reflected in the average Chapter Test results over the past two years (2021–2023), with a Mean Percentage Score (MPS) of 76.64, which is only slightly above the passing rate of 75 and falls under the 75–79: Fairly Satisfactory level according to the DepEd grading scale (DepEd Order No. 8, s. 2015 – Policy Guidelines on Classroom Assessment for the K to 12 BEP). Similar findings on persistent learning gaps in science concepts were also highlighted in related Philippine education studies (Punzalan et al., 2025).

Thus, this study intends to assess students' understanding of the concept using DLHTM, underscoring the importance of enhancing comprehension of the conservation of mechanical energy in physics education.

Objectives

This study aimed to determine the effectiveness of the Division Local Heritage Theme Matrix (DLHTM) integration among Junior High School students in enhancing their knowledge and skills in the conservation of mechanical energy.

The study sought to answer the following research questions:

1. What are the mean scores of students taught using the DLHTM and the traditional teaching method?
2. Is there a significant difference between the test scores of the respondents?
3. How do the post-test results of the two groups taught through the traditional method and the DLHTM compare?
4. How can a lesson plan integrating the DLHTM be developed for Junior High School students?

Hypothesis

Based on the specific objectives, the following null hypotheses were tested:

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Ho1: There is no significant difference between the pre-test and post-test mean scores of students taught using DLHTM and those taught using the traditional teaching method.

Ho2: There is no significant difference in the post-test results between students taught using the traditional teaching method and those taught using DLHTM.

METHODS

Research Design

This study employed a quantitative approach, utilizing a quasi-experimental research design with non-equivalent groups (Hollar, 2017). In this design, two intact Grade 9 classes were assigned as control and experimental groups through a coin toss to ensure fair and unbiased group assignment.

Population and Sampling

The respondents of the study were Grade 9 students under the K-12 Curriculum. A total of 60 students participated, with 30 assigned to the control group and 30 to the experimental group. A single coin toss was used to assign the classes, ensuring unbiased grouping. Only students with no more than two absences during the entire experiment were included in the final data analysis. This criterion was established to ensure that the data collected accurately reflected the impact of the instructional methods on students who had consistently attended and been engaged in the learning process.

Instrument

The researchers administered pre-test and post-test questionnaires to assess students' understanding of the conservation of mechanical energy during the fourth quarter. Both instruments consisted of multiple-choice items specifically designed to measure students' knowledge before and after the intervention.

Data Collection

During the fourth quarter of the 2024–2025 school year, data were gathered from a public secondary school under the Schools Division of Catbalogan City. Two intact Grade 9 classes were identified as the control and experimental groups. A validated 30-item multiple-choice test was administered as a pre-test to both groups in their regular classroom setting to assess their prior knowledge of the conservation of mechanical energy. The experimental group underwent 1 week of instruction using the Division Local Heritage Theme Matrix (DLHTM), while the control group was taught through traditional methods. After the intervention, the same test was administered as a post-test under the same conditions to evaluate students' learning gains. All test papers were collected, scored, and tabulated for statistical analysis.

Treatment of Data

The study used frequency to describe the demographic profile of the respondents. Mean and standard deviation were applied to analyze and compare the average scores and variability of the pre-test and post-test results. The Shapiro–Wilk test was used to check the normality of the data, ensuring the validity of parametric tests. Finally, a t-test was used to determine if there were significant differences between the scores of the control and experimental groups.

Ethical Considerations

The researchers strictly complied with ethical standards by obtaining informed consent and safeguarding the participants' privacy and the confidentiality of their responses throughout the study.

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RESULTS and DISCUSSION

This section presented the analyses of the data obtained and the corresponding interpretation in connection with the specific questions of the study.

Pre-Test and Post-Test Mean Scores of Students in Conservation of Mechanical Energy

The table below presented the comparative data of the controlled and experimental groups in the pretest and posttest assessments.

Table 1. Students' Pre-Test and Post-Test Mean Scores on the Conservation of Mechanical Energy

Group		Pretest		Post Test	
	n	Mean	SD	Mean	SD
Traditional Teaching Method (Control)	30	13.47	4.41	18.07	6.1
DLHTM (Experimental)	30	13.33	3.56	21.77	3.59

The data presented in Table 1 compared the mean scores of students in the controlled and experimental groups during pre-tests and post-tests on the topic of Conservation of Mechanical Energy. The pre-test results revealed that the two groups had nearly identical initial knowledge levels, with mean scores of 13.47 for the controlled group and 13.33 for the experimental group, showing a negligible difference of 0.14. This indicated that both groups started on a relatively equal footing in terms of their understanding of the topic.

After the intervention, the post-test results highlighted a notable improvement in both groups. The control group, which followed traditional teaching methods, achieved a mean post-test score of 18.07, representing a 4.6-point increase from their pre-test score. In contrast, the experimental group, which utilized the Division Local Heritage Theme Matrix (DLHTM), achieved a higher mean post-test score of 21.77, demonstrating an improvement of 8.44 points from their pre-test score.

Furthermore, the lower standard deviation in the experimental group's post-test scores (3.59 compared to 6.1 in the control group) suggested more consistent learning outcomes among students exposed to DLHTM. This consistency supports the idea that localized instruction can help bridge learning gaps and promote equitable understanding. Similar results were found by Young (2020), who reported that culturally contextualized lessons enhanced student comprehension in energy-related topics. This is further supported by Dioneda (2019), who emphasized that localization and contextualization in teaching significantly improved student performance and motivation across subjects. These findings imply that DLHTM fostered deeper engagement and clearer understanding by connecting abstract scientific concepts to students' cultural experiences. In line with this, Petrus (2014) highlighted that contextualized physics instruction not only strengthened understanding and retention but also enhanced problem-solving and academic achievement. Thus, the present study affirmed the value of strategically integrating contextual learning like DLHTM into science education to improve both consistency and performance.

Comparison of the Pre-test and Post-Test Mean Scores Between Control and Experimental Groups

Table 2 presented the comparison of pre-test and post-test mean scores of students in the controlled and experimental groups on the topic of Conservation of Mechanical Energy. The data indicated a statistically significant improvement in the scores of both groups.

Table 2. Comparison of the Mean Pre-test and Post-test Scores of Students in the Control and Experimental Groups

Group	Means		Difference	t	p-value	Interpretation
	Pre-test	Post-Test				
Traditional Teaching Method (Control)	13.47	18.07	4.60	3.34	0.002	S/Reject Ho
DLHTM (Experimental)	13.33	21.77	8.44	9.82	0.000	S/Reject Ho

level of Significance is at 0.05; two-tailed; df:29

For the controlled group, the mean score increased from 13.47 in the pre-test to 18.07 in the post-test, with a mean difference of 4.60. The computed t-value of 3.34 and a corresponding p-value of 0.002 indicate a significant

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improvement, leading to the rejection of the null hypothesis. This result suggested that the traditional teaching method contributed to an enhancement in students' understanding of the concept.

Similarly, for the experimental group, the mean score improved from 13.33 in the pre-test to 21.77 in the post-test, reflecting a higher mean difference of 8.44. The calculated t-value of 9.82 and a p-value of 0.000 confirmed that the improvement was statistically significant, leading to the rejection of the null hypothesis. This indicated that the integration of the Division Local Heritage Theme Matrix (DLHTM) was highly effective in enhancing students' knowledge and skills in the conservation of mechanical energy. The findings of this study were consistent with those of Bello et al. (2023), who found that focusing on localization and contextualization in the Philippines' K-12 curriculum led to improvements in science education. Their study, involving 40 students, demonstrated a significant increase in learning performance (p-values of 0.000) when these methods were applied, highlighting the effectiveness of integrating cultural and contextual elements into teaching.

The difference in post-test mean scores between the experimental group (21.77) and the control group (18.07) was 3.7 points, suggesting that the DLHTM integration was more effective in enhancing students' knowledge and skills in the conservation of mechanical energy. The larger mean difference in the experimental group (8.44 compared to 4.60 in the controlled group) and the higher t-value suggested that the DLHTM integration had a more substantial and meaningful impact on students' learning outcomes than the traditional teaching method. The findings of this study aligned with the research by Obiedo et al. (2017), which highlighted the important role of teaching methodologies in developing cognitive skills and stressed the importance of effective pedagogical strategies. This was consistent with the current study at Persatuan Guru Republik Indonesia (PGRI) University, where the widespread use of traditional methods revealed potential limitations in promoting critical thinking skills.

Comparison of the Post-test Results of the Two Groups of Respondents using Traditional Method and DLHTM

Table 3 presented the comparison of post-test mean scores between students taught using the traditional teaching method and those instructed through the Division Local Heritage Theme Matrix (DLHTM) on the topic of Conservation of Mechanical Energy.

Table 3. Comparison of Post-test Results of Students in the Control and Experimental Groups

Group	n	Post Test Mean	t	p-value	Interpretation
Traditional Teaching Method (Control)	30	18.07	-2.865	0.006	S/Reject Ho
DLHTM (Experimental)	30	21.77			

Level of Significance is at 0.05; two-tailed; df:58

The data showed that the experimental group taught using the Division Local Heritage Theme Matrix (DLHTM) achieved a higher post-test mean score (M = 21.77) compared to the control group taught through traditional methods (M = 18.07). This statistically significant difference ($t = -2.865$, $p < 0.05$) indicates that the DLHTM approach was more effective in improving students’ understanding of the conservation of mechanical energy.

These results supported the effectiveness of contextualized and culturally responsive instruction. As students engaged with familiar cultural elements and real-world applications, they became more actively involved in the learning process. This aligns with Kaminski and Sloutsky (2020), who found that contextualized learning strategies enhance retention and application of scientific concepts. The findings also reflect the assertion of Bassey (2016) that culturally responsive teaching improves academic performance by making instruction more relevant and engaging. Similarly, Will et al. (2022) emphasized that culturally affirming strategies lead to higher motivation and deeper learning.

Through the integration of local heritage themes, the DLHTM made abstract scientific concepts like the conservation of mechanical energy more accessible by linking them to culturally familiar experiences. This connection strengthened students’ understanding and supported long-term retention by building upon their prior knowledge. As a result, learners were able to transfer their understanding to real-life problem-solving tasks, leading to enhanced academic performance.

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Lesson Plan Integrating DLHTM for Junior High School Students

This table provided a structured overview of the lesson plan implementation, highlighting the integration of local heritage in teaching mechanical energy conservation. It outlined the key activities, instructional strategies, and cultural connections used to enhance student engagement and understanding.

Table 4. Integrating the DLHTM into a Lesson Plan for Junior High School Students

Least Learned Competencies/Topic	Lesson Component	Integration in the Lesson Plan
Conservation of Mechanical Energy	Elicit	The lesson began with activities such as "4 Pics 1 Word" and real-life scenarios that utilized local heritage materials. This helped students recall prior knowledge and connect it to the new topic through familiar examples.
	Engage	Students identified and described real-life examples of mechanical energy conservation, especially from local culture.
	Explore	Students applied scientific concepts and mathematical equations to solve energy-related problems using real-world and localized examples.
	Explain	The teacher facilitated discussions on energy transformation by integrating the Division Local Heritage Theme Matrix (DLHTM) to contextualize learning.
	Elaborate	Students conducted investigations and explained energy transformations in mechanical systems using local heritage materials.
	Evaluate	Students evaluated and communicated findings on mechanical energy conservation through structured assessments and reflections.
	Extend	Students demonstrated understanding through problem-solving, innovation, and hands-on applications grounded in local context.

As shown in Table 4, the integration of the Division Local Heritage Theme Matrix (DLHTM) into the 7E learning model provided structured, culturally relevant instruction that enhanced student learning. In the Elicit and Engage phases, students activated prior knowledge and connected new content to familiar cultural experiences through interactive tasks. This approach encouraged motivation and made learning more meaningful, as supported by Aghazadeh (2015) and Dilorio (2022), who emphasized that contextualized activities improve engagement and retention.

During the Explore and Explain phases, students applied scientific concepts to real-life local situations and participated in discussions grounded in community-based examples. This application of inquiry-based learning, aligned with Van Meter et al. (2017) and Saifi et al. (2024), fostered deeper understanding and critical thinking. The use of DLHTM allowed abstract energy concepts to be translated into tangible, localized scenarios.

In the Elaborate and Evaluate phases, students conducted investigations using local materials and assessed their own understanding. This aligns with Reiser (2017) and Hattie & Timperley (2017), who emphasized the role of hands-on learning and formative assessment in knowledge construction and growth. The Extend phase further encouraged students to apply what they learned to real-world challenges within their community, developing creativity and relevance, as noted by Anderson & Krathwohl (2020) and Barton et al. (2024).

Overall, the lesson plan demonstrated that integrating DLHTM into each phase of instruction made the concept of conservation of mechanical energy more accessible, meaningful, and applicable. This highlights the value of localized teaching strategies in promoting both conceptual understanding and real-world problem-solving skills.

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Conclusions

This study concludes that Grade 9 students taught using the Division Local Heritage Theme Matrix (DLHTM) performed better than those taught through the traditional method in understanding the conservation of mechanical energy. The experimental group's higher post-test means score (M = 21.77) compared to the control group (M = 18.07) highlights the effectiveness of contextualized instruction. While traditional methods were effective, DLHTM proved more impactful by linking physics concepts to students' local culture, which led to improved understanding, engagement, consistency in performance, and deeper comprehension. These results supported the integration of localized and culturally relevant approaches to enhance science instruction and promote equitable education among Junior High School students.

Recommendations

Based on the conclusions above, it is recommended that teachers be encouraged to adopt innovative teaching strategies, such as the Division Local Heritage Theme Matrix (DLHTM), to enhance student engagement and understanding of scientific concepts. School administrators should support its implementation by organizing in-service training, providing instructional materials, and fostering a collaborative environment among teachers to promote the exchange of best practices. Curriculum developers are encouraged to incorporate DLHTM-based content in science modules, as its success in teaching energy conservation demonstrates its broader applicability. Education policymakers should promote localized and contextualized instruction models like DLHTM within the K–12 curriculum by issuing guidelines and ensuring resource support. Finally, in light of the positive results of this study, further research is recommended to explore the long-term effects of DLHTM on students' retention and understanding, including how this approach helps students apply the concept of mechanical energy conservation in real-world situations and its potential benefits for other areas of science education.

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