Design and Implementation of Heat Learning Packet (HeLP): Enhancing Conceptual Understanding of Learners on Heat Transfer

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DOI: https://doi.org/10.47772/IJRISS.2026.100500627

Received: 10 May 2026; Accepted: 15 May 2026; Published: 09 June 2026

ABSTRACT

Physics remains a challenging topic in science education, especially in topics related to heat transfer and energy. This study developed a Heat Learning Packet (HeLP) for Grade 9 students to improve their conceptual understanding of heat transfer and energy transformation. Using a Research and Development (R&D) design guided by the ADDIE model, the study was conducted in public schools in Munai, Lanao del Norte, Philippines, involving Grade 9 for initial and final implementation and Grade 10 students for needs assessment, Science teachers, and expert validators. The instruments used included a needs assessment checklist, K to 12 Science Curriculum Guide, researcher-made achievement test, formative assessments, and validator rating sheets. The findings revealed that Heat, Work, and Efficiency was the least learned competency among the Grade 9 physics topics, having M=2.33 for students and M=3.67 for teachers. The developed HeLP was rated excellent (M=4.36) by content validators and complied with all language validation criteria. Students' performance improved after using the learning packet showing in formative assessment that the mean percentage of students' scores is M=85% interpreted as "very satisfactory". There is an increase in students' mean score from M=5.17 in the pre-test to M=11.68 in the post-test. The normalized gain score of 0.67 indicated average learning improvement. These results suggest that the Heat Learning Packet is a valid, acceptable, and useful instructional material that can help address learning gaps and enhance students' conceptual understanding of heat transfer in Grade 9 Physics topics.

Keywords: Heat transfer, Conceptual Understanding, Grade 9 physics, ADDIE model, Heat Learning Packet

INTRODUCTION

Physics remains a challenging topic in science education [1]. The studies showed that students view physics, especially heat transfer, as difficult, traditional, and abstract, which may affect conceptual understanding [2][3][4].

In the Philippines, low science performance of Filipino students in PISA 2018 and 2022, revealing continuing gaps in scientific literacy and conceptual understanding [5][6]. Learning packets are seen as helpful tools because students learn independently, follow guided activities, and monitor progress at their own pace [7][8][9]. SDG 4 (Quality Education) addresses the gap by developing a contextualized, validated, and student-centered Heat Learning Packet (HeLP).

To address these learning difficulties, the study developed Heat Learning Packet (HeLP) for Grade 9 students. The study examined least learned competency in physics, developed and validated the HeLP in terms of its content and language, and determined performance based on formative and assessment. Through this learning packet, the study seeks to enhance conceptual understanding and support effective intervention in physics.

METHODOLOGY

The study was conducted in public schools in Munai, Lanao del Norte, Philippines. It utilizes Research and Development (R&D) design to develop HeLP. The respondents were Grade 9 Basic Education Curriculum students enrolled during SY 2025–2026. One section with forty-eight (48) students for initial implementation, and two sections with seventy-five (75) students for full implementation. Sixty-nine (69) Grade 10 students were respondents for needs assessment. The study also involved teacher respondents and expert validators, including three Science teachers, one language validator, and one ICT validator, who validated the Heat Learning Packet (HeLP) based on scientific accuracy, language quality, instructional design, curriculum alignment, and learner appropriateness.

The instruments used in the study included a needs assessment checklist, the K to 12 Science Curriculum Guide, a researcher-made achievement test, formative assessment, pre- and post-assessment, and validator rating sheets. The needs assessment checklist was used to identify the least mastered competency with 5-point likert scale. The K to 12 Science Curriculum Guide served as the basis for the content of heat transfer and focus of the intervention. A 30-item researcher-made achievement test was developed, validated, pilot-tested, and analyzed before coming up to a final 15-item pre- posttest assessment that will be given to students. Formative assessments were guided by DepEd Order No. 8, s. 2015 where grading scale 75-100 indicates passed, while below 75 indicates failed. Validator rating sheets assessed the quality of the test and HeLP where each rating sheet contained 5-point Likert scale.

The study followed the ADDIE model. In the analysis phase, the researcher conducted a needs assessment to teachers and students in order to determine the learning gaps. In the design phase, the content of the HeLP was aligned with the K to 12 Science Curriculum Guide and organized using the 5E lesson plan. In the development phase, the heat learning packet, achievement test, and related materials were prepared, validated by five validators, and revised based on expert feedback. In the implementation phase, necessary permissions and consent were given to students and parents and secured before pilot testing and full implementation happen. In initial implementation, 30-item test was given to learners which last for 30 minutes. In final implementation, students answered the pre-test before immersing into HeLP, used the HeLP during regular class sessions (1 week), and completed the post-test assessment afterward. The data were analyzed using mean, item analysis, DepEd grading scale, validator rating scales, and normalized gain to determine the quality of the test, the usefulness of the learning packet, and the improvement in students' conceptual understanding of heat transfer.

RESULTS AND DISCUSSIONS

A. Least Learned Topic in Grade 9 Physics

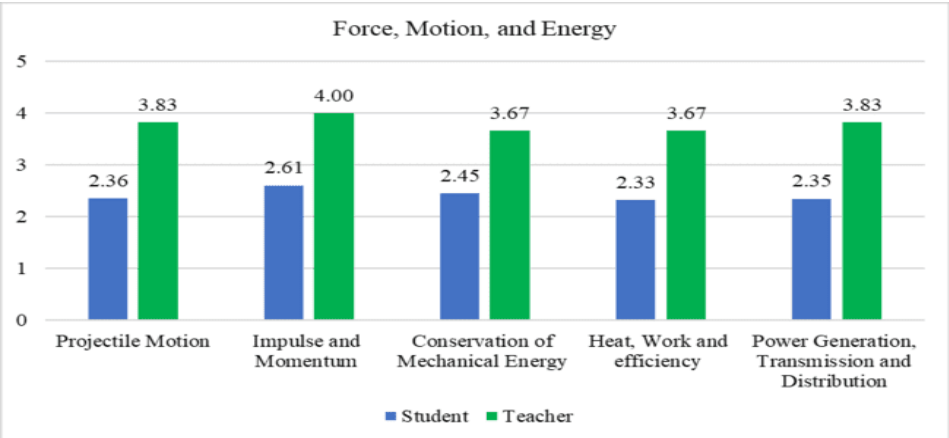


Figure 1. Comparison of the Student and Teacher Least Learned Competency

Figure shows the rating mean of teachers and students on topics under force, motion, and energy. Teachers' mean rating range from 3.67-4.00 while students' mean rating range from 2.33-2.61. Heat, Work, and efficiency garnered the lowest mean among five topics which had a 2.33 mean rating on students while 3.67 on teachers

mean rating. The result supported by the study highlighting that heat transfer is one of the topics in physics that is least perceived by students [10].

B. Unpacking the Learning Competency

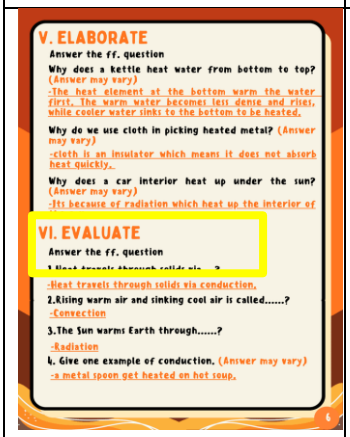
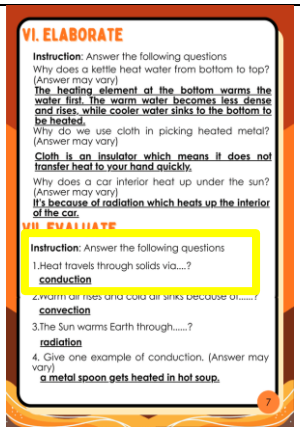
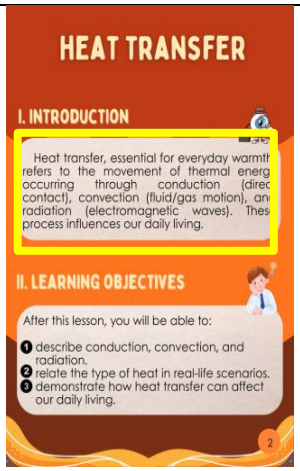
Table 1. K-12 Curriculum Guide Utilize in Heat Learning Packet (HeLP)

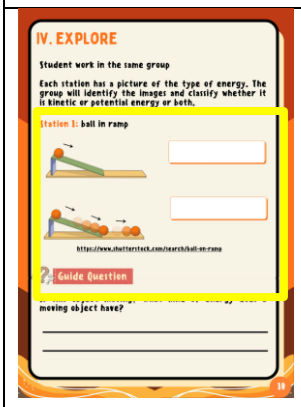
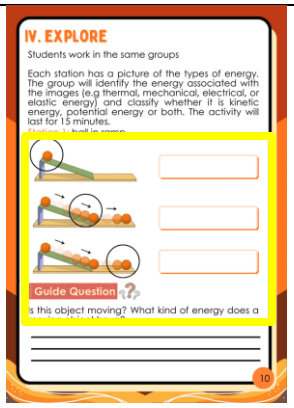
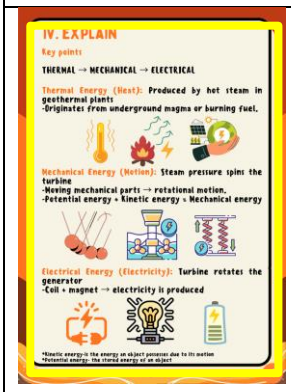
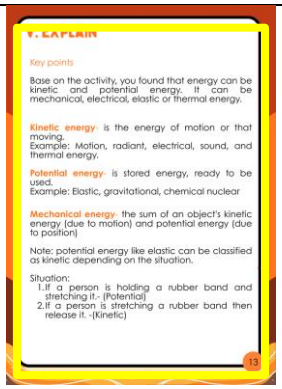
Content	Learning Competency	Objectives
Heat, Work, and Efficiency	Explain how heat transfer and energy transformation make heat engines like geothermal plants.	1.Explain how heat transfer occurs through conduction, convection, and radiation. 2.Describe how heat energy from the earth transforms into mechanical and electrical energy. 3.Illustrate how heat transfer and energy enables geothermal power plant operation.

The table shows that the Heat Learning Packet (HeLP) is aligned with the K–12 competency on Heat, Work, and Efficiency, particularly in explaining heat transfer and energy transformation in geothermal power plants. The objectives emphasize understanding heat transfer and energy processes can be applied to real-life geothermal power plant operation.

C. Sample Version from Version 1-3

Table 2. Revision from Sample Version 1 to Version 2

Version 1	Comments/Suggestions	Version 2
	Make sure that each question that is answerable by “yes or no” or one word only should be answered directly to the point. No more sentences/phrases which can confuse students. Review vague sentences. (V001)	
	Add an introduction in each lesson for the students to have knowledge on what they have reading and answering. (V002)	

	Change some font color and style because it can be overwhelming, make sure that font size is the same, and use images that are in contrast with the background. (V001, V002)	
	Add image to station 1 in order for students to recognize where both kinetic and potential are happening. Make sure to erase the arrow in the first image to identify it as potential. (V003)	
	All the concepts must be properly discussed. Avoid crowded content (V004)	
	Contextualized images like the "maranao" image should be in the packet. (V005)	

The table highlights the revisions made from Version 1 to Version 2 of the HeLP based on validator comments, focusing on clearer questions, including introduction, improved font readability, consistent sizing, and better image contrast. A study highlighted that completeness and accuracy of an intervention improves the quality of learning [11]. The changes also strengthened the learning activities by adding clearer visuals, avoiding crowded content, removing confusing elements, and including contextualized images, making the material more understandable and student-friendly. Which is supported by the study stating that contextualized intervention is important to improve conceptual understanding among learners [12][13].

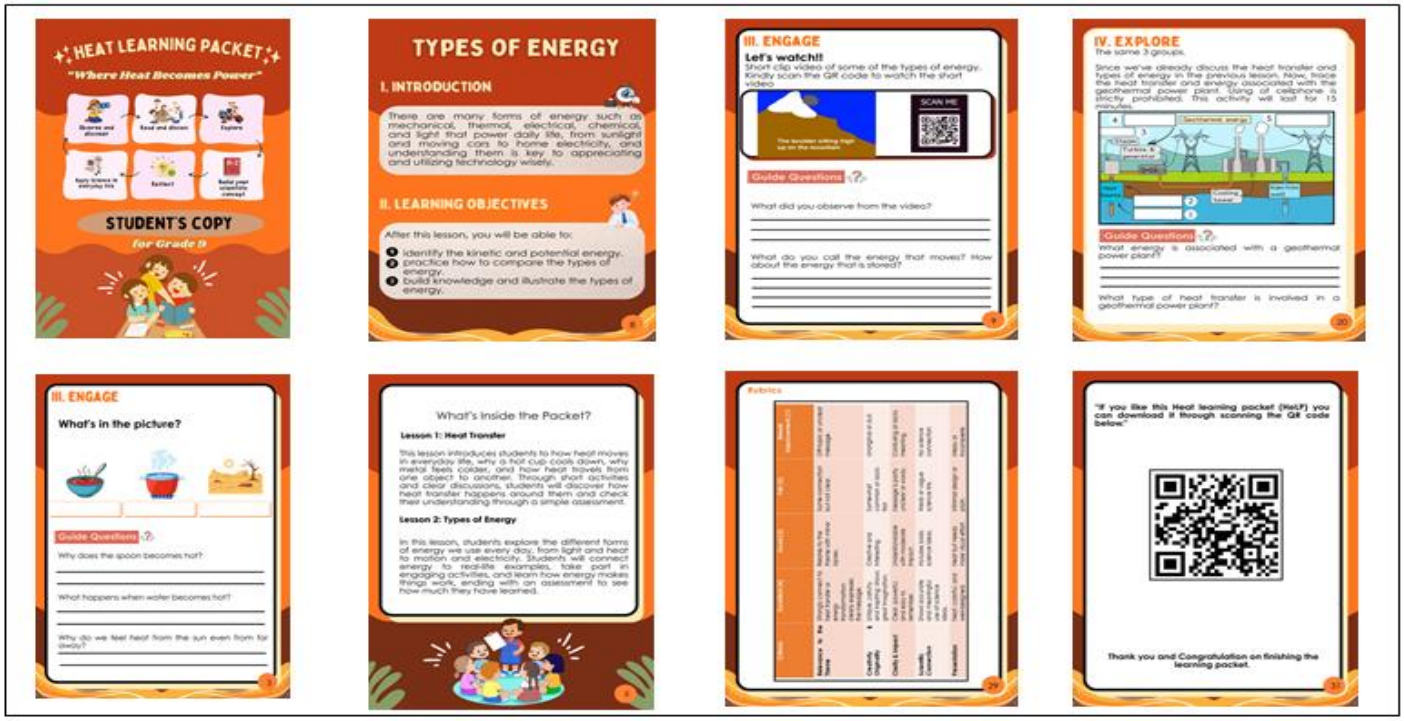


Figure 2. Sample Third Version of Heat Learning Packet

The figure presents the third version of the Heat Learning Packet, showing a more organized, visually appealing, and student-friendly material with objectives, activities, guide questions, rubrics, and QR-based learning support. By placing the QR code in the learning intervention, it made it easier for students to engage in the provided intervention, and make reminders for students to share feedback [14]. The sample pages highlight that the revised packet already integrates interactive and structured learning tasks that can help Grade 9 students understand heat transfer and energy concepts more clearly.

D. Validation of Heat Learning Packet (HeLP)

Table 3. Content Validators' Rating Summary on Heat Learning Packet (HeLP)

Statement	**Mean**	**Description**
1. Content reinforces, enriches, and / or leads to the mastery of certain learning competencies for the level and subject it was intended.	3.75	Very Satisfactory
2. Facts are accurate.	4.75	Excellent
3. Information provided is up-to-date.	5.00	Excellent
4. Language is appropriate for the level of the target user.	5.00	Excellent
5. Visuals are relevant to the text and suitable to the age level and interests of the target user.	4.50	Excellent
6. Visuals are clear in content and detail.	3.75	Very Satisfactory
7. Typographic layout / design adequately supports concepts presented.	4.25	Excellent
8. Size of the letters is appropriate for the target user.	4.00	Very Satisfactory
Average Mean	**4.36**	**Excellent**

The table shows that content validators rated the Heat Learning Packet (HeLP) as excellent, with an average mean of 4.36, showing that the material is accurate, updated, age-appropriate, and generally supportive of the target competencies. The highest ratings were given to both up-to-date information and appropriate language (5.00), while lower but still satisfactory ratings on mastery support and visual clarity (3.75) suggest areas for further refinement. The mean scores mark that intervention is acceptable for classroom use and adhere to Department of Education standards [15].

Table 4. Language Validators' Rating Summary on Heat Learning Packet (HeLP)

Criterion Item	**Description**
Coherence and Clarity of Thought	Complied
Grammar and Syntax	Complied
Spelling and Punctuation	Complied
Consistency in Style	Complied

The table shows that the language validators marked all criteria as complied, indicating that the HeLP has clear thought organization, correct grammar, proper spelling and punctuation, and consistent style. This suggests that the learning packet is acceptable and ready for student use in terms of language quality. Punctuation and capitalization does not only improve writing but also improves learning of students [16].

E. Students Performance on Formative Assessment

Table 5. Students' Performance Distribution Across Lessons 1, 2, and 3

Grading Scale %	**Description**	**Lesson 1**		**Lesson 2**		**Lesson 3**		**Remark**
		n	**%**	**n**	**%**	**n**	**%**	
100-90	Outstanding	14	19	6	8	21	28	Passed
89-85	Very Satisfactory	31	41	29	38	23	31	Passed
84-80	Satisfactory	15	20	26	35	11	15	Passed
79-75	Fairly Satisfactory	11	15	11	15	12	16	Passed
75 below	Did Not Meet Expectation	4	5	3	4	8	10	Failed

The table reveals a clear upward shift in students' achievement, as Lesson 3 recorded the highest percentage of outstanding performance, showing stronger mastery after the learning activities. Student success and academic performance are highly important, as they are closely associated with the positive outcomes that are most valued in education [17]. Still, the presence of learners under did not meet expectations suggests that targeted remediation remains necessary to ensure that no student is left behind.

Table 6. Summary of Performance Outcomes of the Students

Lesson	**Mean Score (%)**	**Interpretation**	**Remarks**
Lesson 1	86	Very Satisfactory	Passed
Lesson 2	84	Satisfactory	Passed

Lesson 2	86	Very Satisfactory	Passed
Overall Mean	**85**	**Very Satisfactory**	**Passed**

The table shows that students achieved an overall mean score of 85%, interpreted as very satisfactory. In lesson 1, students garnered 86%, lesson 2 garnered 84%, while in lesson 3 garnered 86% confirming that they passed the formative assessments after using the Heat Learning Packet.

F. Students Performance on Pre-Test and Post Test

Table 7. Students' Performance Distribution on Pre-Test and Post Test

Grading Scale (%)	**Interpretation**	**Pre-Test**		**Post Test**		**Remarks**
		n	**%**	**n**	**%**	
100-90	Outstanding	0	0	14	19	Passed
89-85	Very Satisfactory	0	0	11	15	Passed
84-80	Satisfactory	0	0	15	20	Passed
79-75	Fairly Satisfactory	1	1	18	24	Passed
75 Below	Did Not Meet Expectation	74	99	17	22	Failed

Table shows a clear improvement in students' performance from pre-test to post-test, as 99% of students were initially in the did not meet expectation level, but many moved to higher performance levels after the intervention. In the post-test, students were distributed across passing categories, with 19% outstanding, 15% very satisfactory, 19% satisfactory, and 24% fairly satisfactory, indicating that the Heat Learning Packet helped improve students' achievement.

Table 8. Summary of Normalized Gain Score of Students

Achievement Test	**Mean**	**Normalize Gain (g)**	**Description**
Pre-test	5.17	0.67	Average
Posttest	11.68		

The table shows that students' mean score increased from 5.17 in the pre-test to 11.68 in the post-test, indicating improved achievement after using the Heat Learning Packet. The normalized gain score of 0.67, described as average, suggests that the intervention produced an average positive learning improvement.

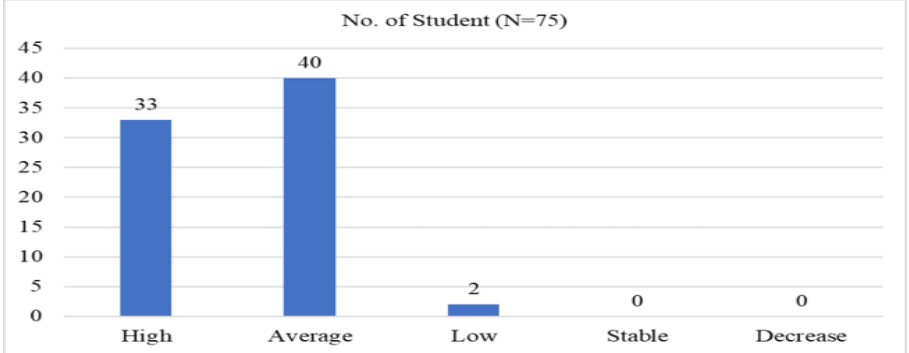


Figure 3. Summary of the Normalized Gain Score Interpretation

Figure shows that most students achieved positive learning gains, with 40 students classified under average and 33 students under high normalized gain. Only 2 students were in the low category, while none were classified as stable or decrease, indicating that the Heat Learning Packet generally improved students' learning performance.

CONCLUSION AND RECOMMENDATION

The result from the normalized gain score of 0.67 falls within the average range, indicating an average but meaningful improvement in conceptual understanding. These findings clearly demonstrate that the developed Heat Learning Packet (HeLP) effectively improves students' difficulties with heat transfer, a topic previously identified as least learned by students and teachers. High evaluation ratings from both panel, content, and language validators regarding content quality, instructional design, and usability further support the effectiveness and acceptability of the intervention. In conclusion, the learning gains, combined with favorable qualitative and quantitative feedback, confirm the effectiveness and usefulness of the developed intervention, thereby suggesting that the HeLP is fit for Grade 9 student-users. Future studies should include a control group to better isolate the effect of the intervention and strengthen causal conclusions.

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to the Department of Science and Technology- Capacity Building Program in Science and Mathematics Education (DOST-CBPSME) for financial support. Thankful also to the Department of Education, School Heads, Teachers, Students participation in becoming the study a successful one. Their contribution is important in developing and implementing the Heat Learning Packet (HeLP).

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