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Development of a Learning Packet on Heat Transfer as Supplementary Materials

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ABSTRACT

Heat transfer is one of the most challenging topics for Grade 7 students due to its abstract nature and persistent misconceptions about conduction, convection, and radiation. These difficulties are often exacerbated by limited instructional resources, lecture-based teaching, and the lack of contextualized materials that support visualization and active learning. This study aimed to develop and validate a printed learning packet on heat transfer as supplementary material to support instruction in Grade 7 science. Using a developmental research design guided by the 4D Model (Define, Design, Develop, and Disseminate), the study began with a needs assessment involving five in-service junior high school science teachers to identify instructional gaps, learning challenges, and material requirements. Findings indicated learner misconceptions, difficulty distinguishing the modes of heat transfer, and limited opportunities for hands-on activities due to resource constraints. Guided by these findings, a printed learning packet incorporating simplified explanations, structured activities, illustrations, and real-life applications was developed and evaluated by five validators composed of in-service science teachers and science education specialists using a standardized rubric. The evaluation yielded a grand weighted mean of 2.85, interpreted as Very Highly Valid, with all criteria rated as Very Highly Acceptable. These results indicate that the developed learning packet is a pedagogically sound and contextually appropriate supplementary material for Grade 7 science instruction. Future studies may implement the packet in classroom settings and examine its effectiveness through pre-test and post-test designs and learner feedback.

Keywords: Heat Transfer, Learning Packet, Supplementary Material, MATATAG Curriculum, Science Education, 4D Model.

INTRODUCTION

Heat transfer is a fundamental yet challenging topic in junior high school science, requiring students to understand how thermal energy moves through conduction, convection, and radiation. However, many learners struggle to visualize these processes, often holding misconceptions such as believing that heat and temperature are the same or that heat travels as a substance (Adadan & Yavuzkaya, 2018; Sozbilir, 2003). In the Philippine context, traditional teaching methods remain heavily lecture-based, limiting opportunities for hands-on and inquiry-driven learning (Isa et al., 2020). These challenges become more pronounced in resource-limited schools where laboratory tools and multimedia materials are scarce. Research emphasizes that conceptual understanding improves when learners are provided with structured, contextualized, and activity-based materials that support visualization and active exploration (Mayer, 1974; Kolb, 1984; Awudi & Danso, 2023). Furthermore, misconceptions about heat transfer persist when instruction lacks real-world applications and scaffolding aligned with students' developmental levels (Driver et al., 1994; Stylos et al., 2021). In response to these instructional gaps, this study developed a printed learning packet grounded in constructivist, experiential, and cognitive theories aimed at strengthening conceptual clarity and supporting science teachers in delivering more interactive lessons. The material is aligned with the MATATAG Curriculum, which emphasizes contextualized, learner-centered science instruction in the Philippines.

Objectives of the Study

This study seeks to achieve:

1. Conduct a needs assessment to determine teachers' experiences, challenges, current practices, and instructional needs in teaching heat transfer, including the use and potential benefits of supplementary printed materials.

2. Develop a supplementary printed learning packet that integrates conceptual content, guided activities, experiments, worksheets, and assessments.

METHODS

This study employed a Research and Development (R&D) research design aimed at systematically developing and validating a printed learning packet on heat transfer as supplementary material for Grade 7 Science. The study was guided by the 4D Model, specifically the Define, Design, and Develop phases, as these were the portions completed by the researcher. Five in-service junior high school science teachers participated in the needs assessment to determine teachers' experiences, challenges, current practices, and instructional needs in teaching heat transfer, including the use and potential benefits of supplementary printed materials. Five validators composed of in-service science teachers and science education specialists evaluated the developed learning packet using an adapted and validated evaluation rubric. The instrument covered key domains, including content accuracy, curriculum alignment, instructional design, clarity of presentation, and relevance of activities. Each indicator was rated using a 4-point Likert scale ranging from 0 (Not Acceptable) to 3 (Very Highly Acceptable). Weighted means and standard deviations were computed to determine the level of validity and acceptability of the developed learning packet.

Data Gathering Procedure

Data were gathered through a Needs Assessment Questionnaire adapted from Hadji Shaeef (2023) and the validator ratings of the developed learning packet using a standardized evaluation rubric adapted from Araya et al. (2024). The questionnaire consisted of open-ended questions designed to elicit teachers' experiences, current teaching practices, observed student difficulties, and suggestions for improving instructional materials on heat transfer. The rubric was used by the evaluators to assess the quality and effectiveness of the learning packet across key components, including content alignment, instructional design, real-life integration, and assessment strategies, ensuring relevance, clarity, and pedagogical appropriateness. Prior to administration, permission from the school administration was secured, and participants were informed about the purpose of the study. Responses were coded anonymously (e.g., NA:ST1–NA:ST5), collected over a two-week period, and transcribed for analysis. Ethical standards were strictly observed to ensure the security and proper handling of all data and documents.

Data Analysis

The data gathered in this study were analyzed using descriptive statistics to interpret the results of the needs assessment and the validator ratings of the developed learning packet. Frequencies and percentages were used to summarize the responses of the five science teachers regarding the challenges in teaching heat transfer, limitations of existing instructional materials, and areas where students commonly exhibit misconceptions. To evaluate the developed learning packet, weighted mean and standard deviation were computed based on the rubric ratings given by the validators. These statistical measures determined the clarity, scientific accuracy, content alignment, and overall pedagogical quality of the material, with scores interpreted on a scale where the highest ratings indicated Very High Validity and High Acceptability. Qualitative comments from validators were analyzed through thematic analysis to highlight specific strengths and recommended improvements for the learning packet.

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RESULTS AND DISCUSSION

Needs Assessment for Science Teachers

Part I. Experience in Teaching Science (Heat Transfer)

Table 1. Summary of In-Service Science Teachers' Responses to the Needs Assessment Survey on Their Experience in Teaching Science (Heat Transfer)

Theme	Coded for	*Quote*
Challenges Due to Limited Resources and Safety Constraints	Lack of materials, insufficient equipment, and safety issues affecting lesson implementation	*"Demonstrating the real transfer of heat between objects... Safety concerns and limited resources make hands-on demonstrations difficult." (NA-ST1)* *"Demonstrating the concept is difficult as it can be harmful to let students do activities with heat sources." (NA-ST3)* *"Some students lack prior knowledge, and insufficient lab materials make it challenging to conduct experiments." (NA-ST2)*
Challenges Due to Student Misunderstanding and Low Engagement	Students' difficulty grasping concepts and low motivation during lessons	*"Students have difficulty understanding abstract concepts because they rely on memorization rather than observation." (NA-ST4)* *"Students often lose focus during lessons and struggle to visualize heat movement. Different learning paces make engagement more challenging." (NA-ST5)*
Integration of Visual and Experiential Learning Approaches	Use of visual aids, demonstrations, simulations, and hands-on experiences	*"To overcome these hurdles, effective teaching strategies must emphasize sensory experiences through hands-on demonstrations like comparing heat conduction in metal and wood..." (NA-ST1)* *"By using visual aids such as showing videos or images and also connecting the discussion to everyday experiences." (NA-ST2)* *"I address students' difficulties by using simple, hands-on activities like heating a metal spoon in hot water for conduction..." (NA-ST4)*
Promotion of Interactive and Student-Centered Learning	Encouraging active participation, group work, and discussion	*"To help students better understand the concept of heat transfer, I use videos, simple demonstrations, and interactive activities such as group experiments and games." (NA-ST5)* *"Real-life examples are the best way to make the topic understandable for students, as well as using visual methods like modules." (NA-ST3)*
Combination of Traditional and Experiential Approaches	Lecture and hands-on	*"I use a mix of lecture and discussion to introduce the concepts, followed by simple experiments using available materials to observe conduction, convection, and radiation." (NA-ST4)*

The needs assessment reveals five major themes describing teachers' experiences in teaching heat transfer, highlighting both instructional challenges and the strategies they use to support student learning. First, teachers reported significant challenges due to limited resources and safety constraints, which restrict them from conducting hands-on experiments. Insufficient laboratory materials and safety risks make it difficult to demonstrate heat transfer processes effectively. This aligns with Reyes and Alonzo (2020), who found that inadequate laboratory resources limit experiential learning and hinder students' understanding of abstract science concepts. Similarly, Mendoza and Villanueva (2023) emphasized that visual and printed instructional materials help compensate for the lack of laboratory tools. Kim and Lee (2021) also noted that safety issues often prevent hands-on activities, but simulations and structured materials can bridge the gap between theory and practice.

Second, teachers emphasized student misunderstanding and low engagement, noting that students often rely on memorization and struggle to visualize heat movement. The abstract nature of heat transfer contributes to disengagement, especially when lessons lack real-life connections. These findings are supported by Santos and Villanueva (2020), who reported that purely theoretical instruction leads to poor conceptual understanding. Ramirez and Cruz (2021) found that visual demonstrations and real-life examples improve comprehension, while Kim and Park (2022) highlighted that multimodal and interactive strategies enhance focus and learning outcomes. Additionally, Mendoza and Alonzo (2019) noted that connecting lessons to everyday experiences increases motivation and relevance.

Third, teachers use visual and experiential learning approaches, such as simple experiments, visual aids, and everyday analogies, to explain conduction, convection, and radiation. These methods help students transform abstract ideas into concrete understanding. This is consistent with Hernandez and Santos (2019), who found that hands-on and visual activities strengthen conceptual learning. Lopez and Villanueva (2020) also showed that real-life examples enhance application of knowledge, while Kim and Lee (2021) emphasized that visualizations help students interpret scientific concepts more accurately. Martinez and Cruz (2022) further demonstrated that simulations, videos, and practical demonstrations increase student curiosity and engagement.

Fourth, teachers prioritize interactive and student-centered learning, using group experiments, collaborative tasks, and games to sustain interest and deepen understanding. These strategies support diverse learning styles and encourage active participation. This mirrors Tan and Reyes (2019), who found that interactive strategies improve retention of complex science concepts. Garcia and Lim (2020) highlighted that student-centered approaches promote critical thinking and engagement in middle school science, while Park and Choi (2021) observed that integrating games and interactive tasks fosters deeper comprehension of abstract ideas. Santos and Velasco (2022) also noted that practical, exploratory activities boost motivation and long-term retention.

Finally, teachers use a combination of traditional and experiential approaches, starting with lectures for foundational knowledge and reinforcing concepts through demonstrations, videos, printed materials, and real-life examples. This blended approach helps students understand and apply heat transfer concepts even with limited resources. Research supports this strategy: Martin and Santos (2019) found that combining lectures with hands-on activities enhances understanding of scientific concepts. Reyes and Velasco (2020) emphasized that experiential learning helps students apply abstract ideas. Cruz et al. (2021) showed that using discussions alongside demonstrations and printed materials creates a more interactive environment, and Gomez and Lim (2022) concluded that blended instruction improves retention and performance.

Overall, the findings highlight the need for supplementary instructional materials, visual resources, and safe alternatives to laboratory experiments to improve the teaching and learning of heat transfer. Despite constraints, teachers effectively integrate multiple strategies to make learning more engaging, meaningful, and accessible for students.

Part 2. Use of Supplementary Printed Materials in Teaching

Table 2. Summary of In-Service Science Teachers' Responses on the Needs Assessment Survey Regarding the Use of Supplementary Printed Materials in Teaching

Theme	Coded for	Quote
Developed of Printed Visual Aids	Use of worksheets and visual aids to	*"I use supplementary printed materials when teaching heat transfer, primarily consisting of worksheets that feature diagrams illustrating conduction, convection, and radiation, along with concise explanations and practice*

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and Worksheets	reinforce learning and comprehension	*problems. These materials provide students with a tangible reference that reinforces learning." (NA-ST1)* *"I use printed materials including worksheets and other visual aids. These are quite effective because they encourage student participation and enhance understanding of the topic." (NA-ST2)* *"In addition to giving students their own copies, printed materials visually show the process of how heat transfers between different materials, making learning clearer and more interactive." (NA-ST3)*
Effectiveness of Supplementary Printed Materials for Independent and Group Learning	Supporting independent and collaborative learning through structured exercises and visual diagrams	*"I use activity sheets and visual diagrams that explain heat transfer in simple terms. They are effective because students can work independently or collaboratively, reinforcing learning even without digital tools." (NA-ST4)* *"Printed worksheets, visual aids, and activity sheets support learning by providing diagrams, exercises, and short passages. They help visual learners and serve as references for review or missed lessons, making lessons organized and accessible." (NA-ST5)*
Enhancement of Comprehension and Independent Learning	Using printed learning packets to improve comprehension, self-paced learning, and engagement	*"A printed learning packet can improve student engagement, comprehension, and self-assessment. It provides structured content, practice problems, self-check quizzes, and diagrams that reinforce understanding and retention." (NA-ST1)* *"It improves comprehension by allowing students to analyze material independently while supporting the main concept." (NA-ST3)* *"The packet helps students learn at their own pace, with clear explanations, diagrams, and exercises, serving as a handy reference for study or review." (NA-ST5)*
Accessibility and Organization in Learning	Providing organized and accessible resources to support inclusive learning	*"Printed materials help students follow lessons in an organized way. They are accessible and convenient, ensuring all students can participate in the learning process." (NA-ST2)* *"These resources allow students to learn at their own pace even without gadgets or internet access. They reinforce key concepts and make learning engaging and accessible." (NA-ST4)*

The table presents the summary results of the assessment in using supplementary printed materials in teaching answered by five science teachers, highlighting the challenges, teaching strategies, and instructional needs in teaching heat transfer in Grade 7 Science. Four themes were identified. The first theme shows that teachers frequently use printed visual aids and worksheets to strengthen understanding of conduction, convection, and radiation. Worksheets with diagrams, explanations, and practice problems provide students with concrete references that support both comprehension and retention. This aligns with Santos and Martin (2019), who found that printed visual aids enhance understanding of abstract science concepts. Velasco and Reyes (2020) similarly reported that structured worksheets with diagrams improve engagement and promote independent learning. Cruz et al. (2021) noted that printed materials help bridge theory and practice, making complex ideas more accessible. In addition, Lim and Gomez (2022) emphasized that visual aids support retention and accommodate diverse learning preferences.

The second theme indicates that supplementary printed materials effectively support both independent and collaborative learning. Activity sheets and visual diagrams allow students to follow step-by-step explanations,

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work independently, or collaborate in groups even without digital tools. These findings are consistent with Santos and Martin (2019), who noted that worksheets provide structure for both individual and group learning. Velasco and Reyes (2020) found that activity sheets strengthen comprehension and teamwork. Cruz et al. (2021) emphasized that printed materials promote continuous learning beyond classroom instruction. Likewise, Lim and Gomez (2022) highlighted that printed diagrams and worksheets benefit visual learners and support inclusive, student-centered learning.

The third theme highlights that printed learning packets enhance comprehension and independent learning. Learning packets provide structured content, practice problems, diagrams, and self-check quizzes that help students learn at their own pace, review lessons, and assess their understanding. These findings reflect Reyes and Santos (2019), who stated that printed learning materials strengthen comprehension through structured activities and visual support. Lim and Cruz (2020) found that self-paced packets increase engagement and personalize learning. Velasco et al. (2021) reported that printed packets improve retention by combining visual and guided elements. Gomez and Tan (2022) further emphasized that structured packets promote self-directed learning and help students apply scientific ideas in real-life contexts.

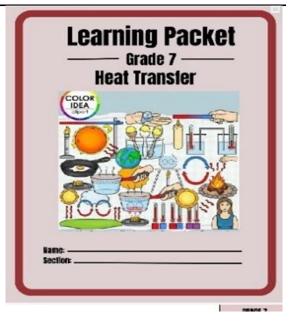
The fourth theme demonstrates that printed materials enhance accessibility and organization in learning, allowing students to participate regardless of access to technology. Printed resources provide clear, organized, and step-by-step guidance that students can use independently, supporting inclusive learning environments. This is supported by Santos and Villanueva (2019), who highlighted that well-structured printed materials help students follow lessons at their own pace. Lim and Gonzales (2020) found that printed resources improve accessibility in low-tech classrooms. Cruz et al. (2021) noted that organized packets increase engagement and understanding through visual and structured activities. Additionally, Medina and Tan (2022) emphasized that printed materials serve as effective alternatives when digital tools are limited, ensuring equitable learning opportunities.

Overall, the findings show that supplementary printed materials such as worksheets, visual aids, and learning packets play a vital role in enhancing student comprehension, supporting independent and collaborative learning, and ensuring accessibility in teaching heat transfer. These materials help simplify abstract concepts, reinforce lessons, and provide structured guidance that supports diverse learners, particularly in contexts with limited technological or laboratory resources.

Development of the Printed Learning Packet on Heat Transfer

Revision 1

Table 1. Face Validation of the Developed Learning Packet on Heat Transfer

Image 1, Before Revision	
Comment/s and suggestion	• Create a unique title for the packet. • Remove the colored elements from the illustration, as they can be distracting. Simplifying the color scheme will help students focus on the main content rather than the decorative artwork.

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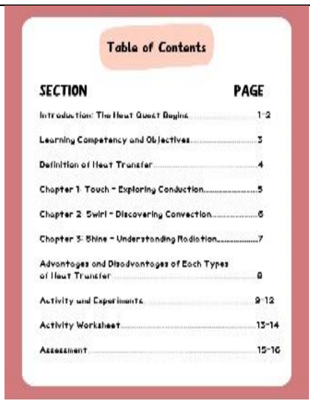
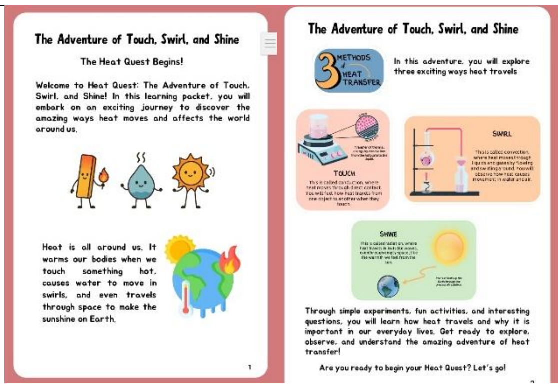
After revision	
Image 2, Before Revision	No table of content provived
Comment/s and suggestion	Add a table of contents to the packet
After revision	 Table of Contents SECTION — PAGE
Image 3, Before Revision	No overview provided
Comment/s and suggestion	It could be enhance with a short overview or visual diagram **before presenting the heat-transfer content.**
After revision	 The Adventure of Touch, Swirl, and Shine The Heat Quest Begins! Welcome to Heat Quest: The Adventure of Touch, Swirl, and Shine! In this learning packet, you will embark on an exciting journey to discover the amazing ways heat moves and affects the world around us. Heat is all around us. It warms our bodies when we touch something hot, causes water to move in swirls, and even travels through space to make the sunshine on Earth. 1 The Adventure of Touch, Swirl, and Shine 3 METHODS of HEAT TRANSFER In this adventure, you will explore three exciting ways heat travels TOUCH SWIRL SHINE Through simple experiments, fun activities, and interesting questions, you will learn how heat travels and why it is important in our everyday lives. Get ready to explore, observe, and understand the amazing adventure of heat transfer! Are you ready to begin your Heat Quest? Let's go!

As shown in Table 4.2.1, the panel recommended revising the packet title to make it more distinct and simplifying the colored elements in the illustrations, since excessive colors may distract students from the key concepts. These adjustments enhance visual clarity and ensure that students focus on the main scientific ideas. This aligns with Hernandez and Santos (2019), who emphasized that visually focused and simplified learning materials help students better grasp abstract scientific concepts. The evaluator also suggested adding a table of contents and including a brief overview or visual diagram before the lesson. These features help organize information and allow students to connect new content with prior knowledge. This recommendation is consistent with Bybee (2013), who highlighted that well-organized instructional materials improve lesson flow, and with Ausubel

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(1968) and Kim and Lee (2021), who found that advance organizers significantly improve comprehension of complex science topics.

Revision 2.

Table 2. Revision of the Developed Learning Packet on Heat Transfer

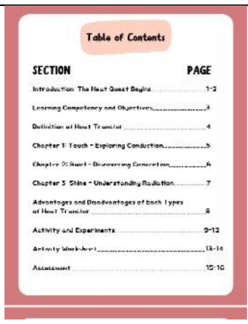
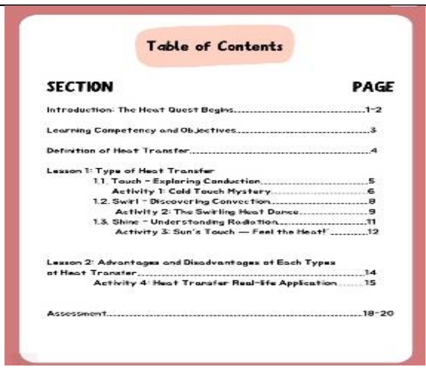
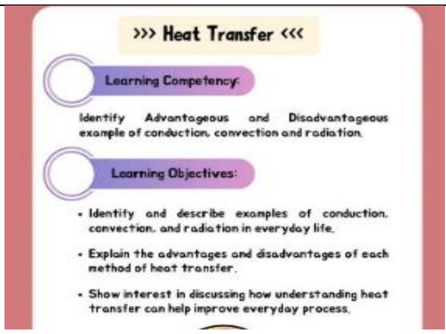
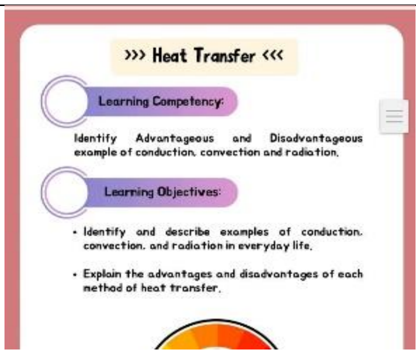
Image 1, Before Revision	 Table of Contents SECTION PAGE Introduction: The Heat Quest Begins ..... 1-2 Learning Competency and Objectives ..... 3 Definition of Heat Transfer ..... 4 Chapter 1: Touch – Exploring Conduction ..... 5 Chapter 2: Swirl – Discovering Convection ..... 6 Chapter 3: Shine – Understanding Radiation ..... 7 Advantages and Disadvantages of Each Types of Heat Transfer ..... 8 Activity and Experiments ..... 9-12 Activity Worksheet ..... 13-14 Assessment 15-16
Comment/s and suggestion	Use “Lesson” instead of “Chapter” in the table of contents, because “Chapter” sounds too broad. Using “Lesson” makes the content feel more focused and appropriate for a learning packet.
After revision	 Table of Contents SECTION PAGE Introduction: The Heat Quest Begins ..... 1-2 Learning Competency and Objectives ..... 3 Definition of Heat Transfer ..... 4 Lesson 1: Type of Heat Transfer 1.1. Touch – Exploring Conduction ..... 5 Activity 1: Cold Touch Mystery ..... 6 1.2. Swirl – Discovering Convection ..... 8 Activity 2: The Swirling Heat Dance ..... 9 1.3. Shine – Understanding Radiation ..... 11 Activity 3: Sun's Touch — Feel the Heat!' ..... 12 Lesson 2: Advantages and Disadvantages of Each Types of Heat Transfer ..... 14 Activity 4: Heat Transfer Real-life Application ..... 15 Assessment 18-20
Image 2, Before Revision	 ››› Heat Transfer ‹‹‹ Learning Competency: Identify Advantageous and Disadvantageous example of conduction, convection and radiation. Learning Objectives: • Identify and describe examples of conduction, convection, and radiation in everyday life. • Explain the advantages and disadvantages of each method of heat transfer. • Show interest in discussing how understanding heat transfer can help improve everyday process.
Comment/s and suggestion	Revise the learning objectives to ensure clear alignment with the lesson content. Remove the third objective since its ideas are already covered in Objectives 1 and 2.
After revision	 ››› Heat Transfer ‹‹‹ Learning Competency: Identify Advantageous and Disadvantageous example of conduction, convection and radiation. Learning Objectives: • Identify and describe examples of conduction, convection, and radiation in everyday life. • Explain the advantages and disadvantages of each method of heat transfer.

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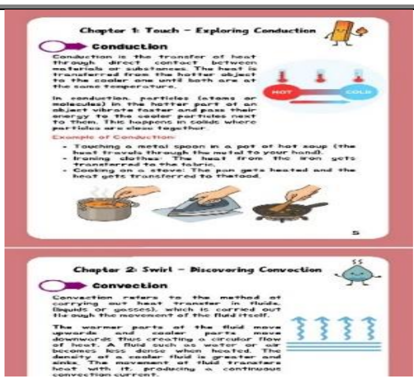
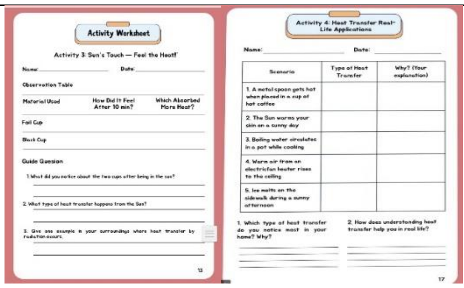
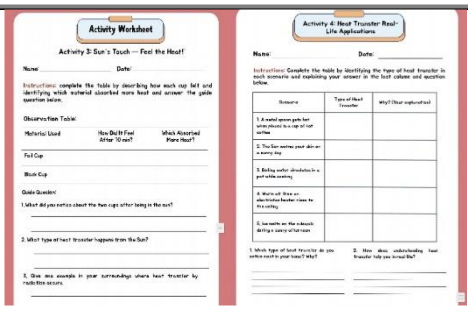
Image 3, Before Revision	 Chapter 1: Touch – Exploring Conduction Conduction Conduction is the transfer of heat through direct contact between materials or substances. The heat is transferred from the hotter object to the cooler one until both are at the same temperature. In conduction, particles (atoms or molecules) in the hotter part of an object vibrate faster and pass their energy to the cooler particles next to them. This happens in solids where particles are close together. Example of Conduction: • Touching a metal spoon in a pot of hot soup (the heat travels through the metal to your hand). • Ironing clothes: The heat from the iron gets transferred to the fabric. • Cooking on a stove: The pan gets heated and the heat gets transferred to thefood. 5 Chapter 2: Swirl – Discovering Convection Convection Convection refers to the method of carrying out heat transfer in fluids (liquids or gasses), which is carried out through the movement of the fluid itself. The warmer parts of the fluid move upwards and cooler parts move downwards thus creating a circular flow of heat. A fluid such as water or air becomes less dense when heated. The density of a cooler fluid is greater and sinks. The movement of fluid transfers heat with it, producing a continuous convection current.
Comment/s and suggestion	Place the activities right after each topic to ensure a clear and logical flow from concept to application
After revision	 Lesson 1: Type of Heat Transfer 1.1 Touch – Exploring Conduction Conduction Learning Activities Activity 1: Cold Touch Mystery

As shown in Table 4.2.2, teachers suggested replacing the term “Chapter” with “Lesson” to make the structure clearer and more appropriate for a learning packet. They also recommended revising the learning objectives to ensure alignment with the content and removing redundant objectives for clarity and precision. These improvements reflect Bybee’s (2013) assertion that clearly defined and organized lesson components support student understanding and engagement. Furthermore, teachers recommended placing activities immediately after each topic to reinforce learning and allow students to practice concepts right away. This supports Kolb’s (1984) experiential learning approach, which emphasizes that understanding deepens when learners apply concepts shortly after they are introduced. Hernandez and Santos (2019) similarly noted that structured and aligned activities enhance retention of abstract scientific concepts, making the packet more effective and student-centered.

Revision 3.

Table 3. Final Revision of the Developed Learning Packet on Heat Transfer

Image 1, Before Revision	 Activity Worksheet Activity 3: Sun's Touch — Feel the Heat! Activity 4: Heat Transfer Real-Life Applications
Comment/s and suggestion	The directions should be placed before each question to guide students clearly on how to respond. Ensure the instructions specify the format expected (e.g., multiple choice, short answer, matching) and are concise but complete. This will help students focus and reduce confusion during assessment.

After revision	

As presented in Table 4.2.3, teachers recommend placing clear directions before each question to guide students on how to respond and minimize confusion during assessment. Providing explicit instructions enhances comprehension and helps students focus on demonstrating understanding. This is aligned with Hernandez and Santos (2019), who noted that clear guidance in instructional materials reduces cognitive load and supports better performance in science tasks. The addition of a table of contents was also recommended to improve organization and navigation of the learning packet. A clear structure allows students to follow the lesson sequence more independently, consistent with Bybee (2013), who emphasized that well-organized materials improve instructional flow and learner engagement. These final revisions ensure that the packet is accessible, user-friendly, and aligned with best practices in science pedagogy

Evaluation of the Printed Learning Packet on Heat Transfer

Table 4. Summary of Rubric Evaluation Results for the Printed Learning Packet

Criteria	Indicator	Weighted Mean	SD	Verbal Interpretation
Content Focus	Integration of heat transfer concepts throughout the packet	2.80	0.45	Very Highly Acceptable
	Clear and contextualized key concepts (conduction, convection, radiation)	3.00	0.00	Very Highly Acceptable
	Alignment with Grade 7 Science standards	3.00	0.00	Very Highly Acceptable
Learning Objective	SMART objectives (Specific, Measurable, Attainable, Relevant, Time-bound)	2.80	0.45	Very Highly Acceptable
	Objectives expressed in behavioral terms	2.60	0.55	Very Highly Acceptable
	Objectives promoting conceptual understanding & inquiry	2.80	0.45	Very Highly Acceptable
Science Content	Accuracy and alignment with science standards	2.80	0.45	Very Highly Acceptable
	Logical and age-appropriate presentation	2.80	0.45	Very Highly Acceptable
	Builds conceptual understanding of heat transfer	2.80	0.45	Very Highly Acceptable
	Encourages independent exploration & application	3.00	0.00	Very Highly Acceptable
Real-Life Connection	Connection of concepts to real-life contexts	3.00	0.00	Very Highly Acceptable

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Assessment	Integration of diagnostic, formative, summative assessments	2.60	0.55	Very Highly Acceptable
	Supports understanding and critical thinking	3.00	0.00	Very Highly Acceptable
Instructional Design	Clarity of format, layout, and flow	2.80	0.45	Very Highly Acceptable
	Clear directions, visuals, structured activities	3.00	0.00	Very Highly Acceptable
Closure Activities	Reflection or synthesis at lesson end	2.60	0.55	Very Highly Acceptable
	Linking content to real-world situations	3.00	0.00	Very Highly Acceptable
	Overall	**2.85**	**0.28**	**Very Highly Acceptable**

The evaluation results presented in Table 4 show that the Printed Learning Packet on Heat Transfer is highly acceptable across all major criteria, with weighted means ranging from 2.60 to 3.00. Strengths emerged in content clarity, alignment with Grade 7 standards, well-designed visuals, and real-life contextualization—each receiving perfect ratings of WM = 3.00. The packet effectively integrates key concepts such as conduction, convection, and radiation, while also promoting independent application, critical thinking, and meaningful connections to everyday experiences. These findings align with studies highlighting that clear explanations and contextualized science content significantly improve students' conceptual understanding of heat and temperature (Adadan & Yavuzkaya, 2018; Stylos et al., 2021). Similarly, research emphasizes that structured visual aids and real-life examples help learners overcome difficulties with abstract scientific concepts, supporting the strong evaluator response to the packet's instructional design (Lopez & Villanueva, 2020; Rivera & Torres, 2023).

However, slightly lower ratings of 2.60 to 2.80 in behavioral objectives, varied assessment types, and reflection or synthesis activities suggest areas for refinement. These findings indicate the need to strengthen the packet's alignment with performance-based learning and assessment diversity. Educational literature supports these conclusions: studies show that clearly written behavioral objectives enhance learning direction and outcomes (Depaepe et al., 2015), and that integrating diagnostic, formative, and summative assessments promotes deeper conceptual understanding and metacognition (Danili & Reid, 2004). Additionally, research confirms that reflection-based activities are essential for reinforcing conceptual change, especially in heat and thermodynamics topics (Lee, 2014; Valkanou et al., 2024).

Overall, the evaluation and supporting literature affirm that the Printed Learning Packet is an instructionally sound, curriculum-aligned, and effective learning tool for Grade 7 science, yielding an Overall Mean of 2.85 (SD = 0.28). With targeted improvements in learning objectives, assessment variety, and reflective components, the packet has strong potential to advance from "highly acceptable" to an exemplary instructional material grounded in evidence-based science teaching practices.

CONCLUSION AND RECOMMENDATIONS

This study developed and validated a printed learning packet on heat transfer to address the challenges identified by teachers such as lack of resources, safety limitations, and students' misconceptions highlight the importance of providing structured, accessible, and activity-based materials that can enhance classroom instruction even in resource-constrained environments. The learning packet, designed using the 4D Model, received a grand weighted mean of 2.85 (Very Highly Acceptable), confirming its clarity, accuracy, and strong alignment with curriculum standards. Teachers agreed that the material effectively simplifies conduction, convection, and

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radiation, supports independent learning, and enhances engagement through structured activities and real-life examples.

In light of these findings, it is recommended that the learning packet be used as supplementary material in teaching heat transfer, especially in resource-limited classrooms. Future enhancements may focus on improving behavioral objectives, diversifying assessment tasks, and incorporating more reflection activities. Teacher orientation on the effective use of activity-based printed materials is also encouraged. Further research using classroom implementation and pre-test–post-test designs is recommended to determine the packet's impact on student learning and misconception reduction.

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