The Development of RBL-STEAM Learning Design to Improve Climate Change Literacy Through the Construction of Energy-Efficient Houses in Sixth Grade of Elementary School Students

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ABSTRACT: Climate change literacy is essential for preparing future generations to understand environmental challenges and take an active role in mitigation and adaptation efforts. This study aims to enhance students' climate change literacy through the development of Research-Based Learning (RBL) integrated with the STEAM approach, which combines Science, Technology, Engineering, Arts, and Mathematics. Students were engaged in the construction of energy-efficient house projects that incorporated simple electrical circuits, allowing them to apply scientific concepts in a meaningful context. The study employed a research and development methodology using the 4D model, which consists of the stages Define, Design, Develop, and Disseminate. The developed learning materials included lesson plans, student worksheets (LKPD), and a climate change literacy test. A sequential exploratory mixed-methods design was implemented, beginning with qualitative data collection and analysis, followed by quantitative data collection and analysis. The study was conducted at SDN Banjarwungu 2 as the experimental group and SDN Gempolklutuk as the control group. The findings indicate that the RBL-STEAM learning materials are valid, practical, and effective in improving students' understanding of the causes, impacts, and potential solutions to climate change. The study concludes that integrating RBL-STEAM with project-based learning activities can significantly enhance climate change literacy in primary education.

KEYWORDS: Climate Change Literacy, Energy-Efficient House Construction, Learning Materials, RBL-STEAM.

INTRODUCTION

Climate change is one of the most urgent global challenges facing humanity today [1]. Its impacts are increasingly evident and widespread, including rising global temperatures, prolonged droughts, sea-level rise, melting polar ice, and more frequent extreme weather events. These phenomena have serious implications not only for the environment but also for public health, food security, economic stability, and the sustainability of future generations. Therefore, education systems across the world must take a proactive role in preparing students to understand, respond to, and take informed action on climate-related issues [2]. One of the most effective ways to address this challenge is by fostering climate change literacy from an early age.

Climate change literacy involves not only acquiring knowledge about the scientific causes and effects of climate change but also developing the ability to critically analyze environmental problems, evaluate solutions, and take responsible action [3]. This form of literacy extends beyond reading comprehension or basic scientific knowledge. It includes understanding interconnected systems, interpreting data, making informed decisions, and acting ethically in response to environmental issues [4]. Such competencies are best cultivated through active, inquiry-based, and contextual learning approaches that connect academic content with real-world applications.

Integrating climate change literacy across school curricula is therefore essential [5]. Subjects such as science, geography, environmental studies, and life skills education offer natural entry points for embedding climate-related themes. However, in many classrooms, particularly in primary education, climate change is still taught in a limited and abstract way. Instruction often relies on textbook explanations without engaging students in meaningful, hands-on experiences that help them internalize and apply what they learn [6]. As a result, students may acquire basic knowledge but lack the deeper understanding and personal relevance necessary to become informed and responsible global citizens.

To respond to this gap, education must evolve toward pedagogical models that not only deliver content but also cultivate higher-order thinking skills and practical competencies. One promising approach is the integration of Research-Based Learning (RBL) with the STEAM framework, which combines science, technology, engineering, arts, and mathematics [7]. The RBL-STEAM model encourages students to become active participants in the learning process. Rather than passively receiving information, students are guided to investigate problems, design and conduct experiments, analyze data, draw conclusions, and present their findings [8]. This process mirrors the way scientists approach real-world challenges and helps students develop a scientific mindset.

The RBL-STEAM model supports both content mastery and the development of 21st-century skills. These skills include critical thinking, creativity, collaboration, communication, and problem-solving abilities, all of which are increasingly important in a complex and rapidly changing world [12, 13]. In the Indonesian context, the development of these competencies is aligned with national education priorities, including the Merdeka Belajar curriculum and the National Literacy Movement. These initiatives emphasize student-centered learning, contextual relevance, and the cultivation of literacies that go beyond traditional academic subjects.

Moreover, the Indonesian Ministry of Education, Culture, Research, and Technology has recognized the importance of improving student literacy through international benchmarking. The 2022 Programme for International Student Assessment (PISA) showed improvements in Indonesian students' reading scores compared to 2018. However, challenges remain in achieving deeper, conceptual understanding, particularly in scientific and environmental domains. This reinforces the need for innovative instructional designs that align with global standards while addressing local needs.

One real-world application of the RBL-STEAM approach is through the construction of energy-efficient house prototypes. This project-based activity provides a concrete context for students to explore concepts such as energy use, sustainability, and electrical circuits. In this activity, students design and build miniature houses equipped with both series and parallel electrical circuits using simple and recyclable materials. The project integrates multiple disciplines, requires critical thinking and collaboration, and encourages students to reflect on the environmental impact of energy consumption. It also introduces them to environmentally friendly practices such as reusing materials and conserving electricity.

To implement this learning experience effectively, structured and comprehensive learning materials are essential [16]. These materials must support the full RBL process, from identifying problems to designing investigations and synthesizing findings. They should include teaching modules, instructional materials, student worksheets (LKPD), multimedia learning materials, and assessments to evaluate both conceptual understanding and applied skills. Such learning materials must also be adaptable, context-sensitive, and engaging, especially for primary school students who benefit most from experiential and visual learning [17].

This study focuses on the development of RBL-STEAM-based learning materials aimed at improving climate change literacy among elementary school students. The materials are designed around the topic of electrical circuits and integrated with mathematical concepts such as mixed number operations. These subjects are combined with the real-world theme of building energy-efficient homes, allowing students to explore abstract concepts through practical application. By engaging in this project, students are expected to develop a deeper understanding of climate change, recognize its causes and long-term effects, and explore actionable solutions that can be implemented in daily life.

Furthermore, this approach is designed to promote environmental awareness and responsibility. As students work through each stage of the RBL process, they are not only learning academic content but also practicing inquiry, collaboration, and reflective thinking [14]. They are encouraged to explore the broader implications of energy use and climate change, make evidence-based decisions, and share their findings with peers. This process strengthens their ability to address real-life problems with creativity and confidence [15].

In summary, the purpose of this study is to design and implement a learning model based on the integration of Research-Based Learning and STEAM to improve students' climate change literacy. Through the development of structured learning materials and project-based activities, this research aims to provide an innovative educational framework that supports both conceptual understanding and the development of practical, future-oriented skills. The intended outcome is not only to improve student knowledge about climate change but also to empower them to become active participants in building a more sustainable future.

METHOD

This study employed a research and development (R&D) approach, aiming to address instructional problems, particularly those related to the design and implementation of learning materials [10]. The current learning process in the target context remains largely conventional and lacks alignment with the demands of 21st-century education. Today's educational landscape requires learning

models that support essential 21st-century skills such as collaboration, creativity, and technological literacy. These competencies emphasize the need for student-centered learning, where teachers are expected to be both creative and innovative in facilitating instruction.

One suitable instructional method aligned with 21st-century learning principles is the integration of Research-Based Learning (RBL) with the STEAM approach, which encompasses science, technology, engineering, arts, and mathematics. Therefore, this study aimed to develop a product in the form of RBL-STEAM-based learning materials designed to improve students' climate change literacy through the construction of energy-efficient house prototypes. The development process adopted the 4D model proposed by Thiagarajan, which consists of four stages: Define, Design, Develop, and Disseminate [11].

The study was conducted during the second semester of the 2023–2024 academic year, specifically in March 2024. The research population included one school cluster comprising seven elementary schools. The research subjects were sixth-grade students from SDN Banjarwungu 1, which served as the experimental group, and SDN Gempolklutuk, which served as the control group. Both schools are part of Cluster 4 in Tarik District, Sidoarjo Regency.

This study used a mixed-methods approach, combining both quantitative and qualitative data collection techniques. Quantitative data were obtained through expert validation of the learning materials, analysis of student learning outcomes based on worksheets (LKPD) and climate change literacy tests, and evaluation of student responses to the use of the LKPD and learning media through questionnaires. The validation sheets and questionnaires employed a Likert scale and included open-ended questions to gather suggestions from experts and perceptions from students as end users.

Qualitative data were collected through expert feedback regarding the appropriateness of the learning materials and through direct classroom observations during the implementation of the LKPD and learning media. Instruments used in the data collection process included expert validation forms, student worksheets, climate change literacy tests, student response questionnaires, and observation sheets. The data were analyzed using descriptive analysis for both qualitative and quantitative data, as well as inferential statistics to evaluate student performance.

Student achievement data obtained from the climate change literacy tests were analyzed using a t-test. The results were then compared to the Minimum Mastery Criteria for Learning Objectives (KKTP) to assess the effectiveness of the RBL-STEAM learning materials in improving climate change literacy among sixth-grade students at SDN Banjarwungu 1, Tarik District.

RESEARCH FINDINGS

Syntax of RBL-STEAM Learning for Climate Change Literacy

To enhance students' literacy regarding climate change, this study focuses on the use of recycled materials to create a hydro-powered lamp project. The study is grounded in an instructional model that applies Research-Based Learning (RBL) integrated with the STEAM approach. The implementation of the RBL-STEAM model is linked to the topic of climate change through the teaching of electrical circuits in the IPAS (Science and Social Integration) subject for sixth-grade elementary school students.

In this learning process, students take the central role while the teacher acts as a facilitator and motivator. This student-centered approach allows learners to develop their abilities independently and optimally. The application of this instructional model in the context of climate change aims to: (1) increase the contextual relevance of the subject matter, (2) promote higher-order thinking skills for problem-solving, (3) internalize learning through practical experience, and (4) strengthen students' understanding of sustainable scientific development [9].

The following is the RBL-STEAM framework developed to improve climate change literacy among sixth-grade students. This framework is designed to help students address climate change issues through the construction of energy-efficient house prototypes, thereby enhancing their environmental literacy. In the initial stage of the RBL syntax, the problem presented originates from an open-ended issue formulated by the research team. The study emphasizes the construction of energy-efficient house models as the core learning project. This instructional design incorporates all six components of STEAM. A detailed depiction of the integrated RBL-STEAM framework for this purpose is presented in the Figure 1.

Energy-Efficient House Construction to Enhance Climate Change Literacy

The use of instructional media made from recycled materials to create energy-efficient house models presents a highly relevant area of research, particularly in relation to sustainable energy education. This approach focuses on the development of practical, solution-oriented learning activities that aim to improve students' understanding of energy conservation. The significance of this research includes: increasing students' awareness of energy-saving strategies, promoting the reuse of materials to reduce environmental waste, and fostering innovation and technological development. Through this study, learning solutions are developed that utilize recycled materials in the construction of energy-efficient house models to enhance students' comprehension of climate change and sustainability.

Science	Technology	Engineering	Art	Mathematics
Utilizing used styrofoam as construction material for building energy-efficient house models and studying its environmental impact in the local surroundings.	Using search engines and Android-based tools to explore various types of energy-saving house designs and recycled material innovations.	Designing energy-efficient houses and electrical installations that function effectively, using reused materials such as styrofoam.	Creating proportional and well-structured models of energy-efficient houses with attention to aesthetics and presentation.	Applying measurement and calculation concepts in the design and construction of energy-efficient house models

Figure 1. Identification and Analysis of Problems in RBL-STEAM Learning

Figure 1 illustrates the correlation between elements of Science and Mathematics learning within the RBL-STEAM framework, aimed at enhancing climate change literacy as a central problem-solving focus in this study. The use of recycled materials such as styrofoam in the learning project serves not only to foster students' creativity but also to instill a sense of environmental responsibility. Through this activity, students are guided to understand the importance of reducing waste by applying the principles of reuse and recycling, which are essential components of sustainable education.

This project offers students hands-on experience in how waste materials can be transformed into useful products, contributing to waste reduction and generating a positive environmental impact. Students learn that creativity is not limited to academic settings but also plays a vital role in daily life and in preserving the environment. Such experiences encourage the development of practical awareness and socially responsible behavior among learners.

The instructional components developed under the RBL-STEAM approach are based on a learning strategy that integrates Research-Based Learning (RBL) with the interdisciplinary elements of Science, Technology, Engineering, Arts, and Mathematics (STEAM). Table 1 presents the core aspects of RBL-STEAM-based learning applied in this study, illustrating how each component contributes to the development of students' climate change literacy through contextual, inquiry-driven, and interdisciplinary activities.

Table 1. Instructional Aspects of RBL-STEAM Learning

The integration of science, technology, engineering, art, and mathematics in the construction of energy-efficient house prototypes provides students with a holistic learning experience. Through this interdisciplinary approach, students not only develop critical and creative thinking skills but also gain an understanding of the interconnectedness among disciplines when addressing real-world problems. This innovation plays a significant role in enhancing climate change literacy and holds considerable potential for reducing environmental impact through the use of waste materials and the application of energy-efficient concepts.	
Science	Students examine environmental issues in their surroundings, specifically the accumulation of used styrofoam waste. They identify the root causes of the problem and explore appropriate solutions by repurposing the waste as raw material for a learning project.

Technology	Students utilize technology, including the internet and digital devices, to gather information on how to process used styrofoam waste and to explore product design inspirations related to its reuse.
Engineering	Students design and develop energy-efficient house prototypes using recycled styrofoam. The process includes planning, selecting appropriate materials, and testing the structural integrity of the product. In addition, they conduct evaluations to assess the quality and functionality of the final prototype.
Art	Students develop artistic skills by incorporating aesthetic elements into their energy-efficient house prototypes, such as coloring and adding creative details to enhance visual appeal. This stage of the project supports students in expressing their creativity and visual aesthetics, contributing to a more meaningful and engaging learning experience.
Mathematics	Students apply geometric concepts in measuring three-dimensional shapes and perform mixed operations with whole numbers. They also analyze the data obtained during the product testing phase and make improvements based on the results of their evaluation.

This activity provides students with valuable experience in processing relevant information and raises their awareness of the actions needed to address the impacts of climate change in their local environment. Within the RBL-STEAM approach, the learning process is structured into several stages: (1) identifying core problems related to the effects of climate change and exploring the use of solar panels as an alternative energy source for conserving electricity and water, (2) developing solutions by applying capillary and drip irrigation technologies and assembling an automatic watering system using solar panels and smart sensors, (3) gathering information related to the construction of energy-efficient houses equipped with electrical circuits, (4) calculating electrical power and energy costs, and (5) reporting the results of research and observations related to students' climate change literacy. A detailed representation of the integrated RBL-STEAM framework is presented in Figure 2.

The results of the study indicate that the use of RBL-STEAM learning materials in the project of constructing energy-efficient houses from recycled styrofoam effectively enhances students' creativity, including originality of ideas, cognitive flexibility, and problem-solving abilities. This project also proves effective in fostering students' understanding of the importance of waste utilization, while contributing positively to the development of environmental awareness and creative thinking skills.

Purpose and Objectives of Student Learning

The learning objectives derived from the implementation of Research-Based Learning combined with the STEAM approach are designed to enable students to develop both knowledge and skills across the disciplines of science, technology, engineering, arts, and mathematics. The intended goals and learning outcomes for students are as follows:

1. Students are able to accurately analyze key information from explanatory texts.
2. Students are able to identify important information from explanatory texts related to global warming.
3. Students are able to present key information from explanatory texts after reading passages about global warming.
4. Students are able to recognize the structural elements of explanatory texts after reading about global warming.
5. Students are able to explain methods for conserving energy.
6. Students are able to describe the impacts of climate change.
7. Students are able to create an energy-efficient house prototype.
8. Through the project of constructing an energy-efficient house, students are able to examine electrical components and their functions accurately.
9. Students are able to analyze the strengths and weaknesses of simple electrical circuits through the energy-efficient house project.
10. Students are able to formulate observations regarding electrical components and their functions in a simple circuit using the energy-efficient house project.
11. Students are able to calculate estimated electricity usage and cost.

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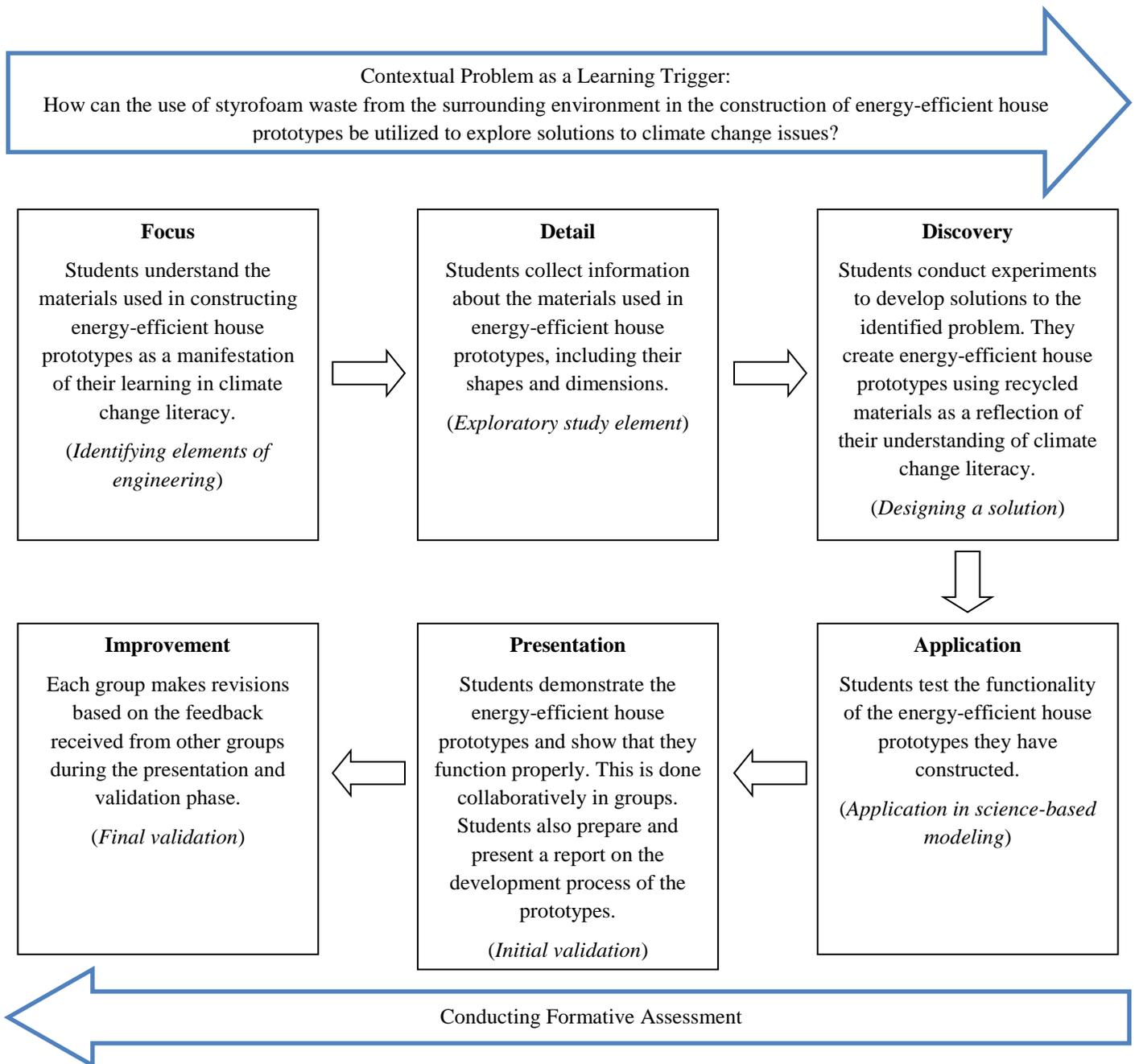
Contextual Problem as a Learning Trigger:

How can the use of styrofoam waste from the surrounding environment in the construction of energy-efficient house prototypes be utilized to explore solutions to climate change issues?

Focus

Students understand the materials used in constructing energy-efficient house prototypes as a manifestation of their learning in climate change literacy.

(*Identifying elements of engineering*)

Detail

Students collect information about the materials used in energy-efficient house prototypes, including their shapes and dimensions.

(*Exploratory study element*)

Discovery

Students conduct experiments to develop solutions to the identified problem. They create energy-efficient house prototypes using recycled materials as a reflection of their understanding of climate change literacy.

(*Designing a solution*)

Improvement

Each group makes revisions based on the feedback received from other groups during the presentation and validation phase.

(*Final validation*)

Presentation

Students demonstrate the energy-efficient house prototypes and show that they function properly. This is done collaboratively in groups. Students also prepare and present a report on the development process of the prototypes.

(*Initial validation*)

Application

Students test the functionality of the energy-efficient house prototypes they have constructed.

(*Application in science-based modeling*)

Conducting Formative Assessment

Figure 2. RBL-STEAM Framework for Climate Change Literacy

Instructional Elements in the Development of RBL-STEAM Learning

1: Scientific Problem Element

The construction of an energy-efficient house is a project or model designed to optimize energy use within a household. Its primary objective is to reduce energy consumption and promote environmental sustainability. This project introduces students to the principles of energy efficiency and methods for reducing household energy usage. Additionally, the construction process utilizes recycled materials, making the project clean, cost-effective, and environmentally friendly.

Figure 3. Recycled Materials in the form of used Styrofoam

2: Technology Element

Students utilize technology, particularly search engines such as Google, to gather information related to the development of hydro-powered lamp prototypes. They also use the internet to explore design concepts and techniques for constructing energy-efficient house models.

https://www.youtube.com/watch?v=1FqwUBvEw-A

https://www.youtube.com/watch?v=aMlWzWXG1-k

https://www.youtube.com/watch?v=K_qKdMyTlkI

Figure 4. Students using Computers or Mobile Devices

3: Engineering Element

Students are expected to design and construct models of energy-efficient houses, including electrical installations, as part of efforts to address climate change. They are also encouraged to utilize recycled materials during the construction process to promote environmental responsibility and sustainability.

Figure 5. Students Designing Energy-Efficient Houses

4: Art Element

As illustrated in Figure 6, the integration of art in the construction of energy-efficient houses allows students to enhance their prototypes through visual and aesthetic design. Students apply artistic skills by selecting colors, decorating surfaces, and organizing

the layout of their models to create visually appealing and meaningful representations. This creative process fosters students' ability to communicate ideas through visual expression, supports the development of artistic awareness, and deepens their engagement with environmentally conscious design. The inclusion of art in the STEAM framework also helps students make connections between form, function, and message in the context of climate change awareness.

Figure 6. Final Prototypes of Energy-Efficient House Constructions

5: Mathematics Element

The mathematical concepts addressed in this learning activity include understanding measurement, performing integer addition, and applying these skills in real-life contexts. Students engage in calculating electrical power and estimating electricity costs based on their energy-efficient house prototypes. This application helps students connect mathematical reasoning with practical decision-making related to energy consumption.

RBL STEAM Learning Framework

This section discusses each of the six stages of the research-based learning model combined with the STEAM approach. These six stages illustrate how students engage in the learning process by analyzing energy-efficient house prototypes as a means to improve their climate change literacy and contribute to mitigating the effects of climate change. This instructional framework serves as an effort to integrate the Research-Based Learning (RBL) model with the STEAM approach and to support learning experiences that are more contextual and relevant to real-world challenges.

In the initial stage, students are introduced to fundamental issues related to climate change and the role of energy-efficient housing in reducing electricity consumption. The activity begins with the teacher presenting a video on climate change, followed by a guided class discussion to reflect on the content of the video. After observing and discussing the video, the teacher poses a problem for students to consider: how can individuals help reduce the impacts of climate change? The RBL-STEAM framework is structured as follows:

1: Problem or Challenge Identification

At this stage, there is a fundamental issue related to climate change and the use of energy-efficient houses as part of efforts to conserve electrical energy. Further details are provided in Table 2.

Table 2. Problem Orientation Stage

Stage 1	Learning Activities
Problem Orientation	Students observe a video about climate change (https://www.youtube.com/watch?v=29jyaPlWzFI).
	Students and the teacher engage in a question-and-answer session regarding the video, focusing on the following: a. What are the causes of climate change? b. How can climate change be addressed?
	The teacher encourages students to express their opinions with confidence.
	The teacher acknowledges students' responses and reinforces the importance of reading for gaining knowledge.

2: Organizing Students for Learning

At this stage, students are organized into groups to promote collaborative and diverse teamwork. Further details are presented in Table 3.

Table 3. Organizing Students for Learning

Stage 2	Learning Activities
Organizing Students for Learning	The teacher divides the students into four groups, with each group consisting of four members.
	Students examine an explanatory text titled "Global Warming", presented using a PowerPoint presentation.
	Students complete Worksheet 1 (LKPD 1), which is provided by the teacher and is related to the explanatory text.
	Students are asked to present the results of their group work in front of the class.

3: Guiding Individual or Group Investigations

This stage involves guiding students as they conduct investigations either individually or in groups. During this phase, students are encouraged to develop and explore ideas, gather data, and design experiments or projects to address the questions or problems posed. Students are given the opportunity to engage in experiments, simulations, or real-world projects that allow them to apply theoretical concepts to practical situations. One example is the development of an energy-efficient house design. The instructional steps for this stage are outlined in Table 4.

Table 4. Guiding Individual or Group Investigations

Stage 3	Learning Activities
Guiding Individual or Group Investigations	The teacher guides students to observe a video on how to create an energy-efficient house design. (https://www.youtube.com/watch?v=1FqwUBvEw-A)
	After watching the video, students are provided with Worksheet 2 (LKPD 2) to be completed individually.
	The teacher gives instructions related to the completion of the worksheet, which is connected to explanatory texts.
	As a brief energizer, students engage in a group clap game: "Clap 1... Clap 2... Clap 3..."
	In groups, with the teacher's guidance, students design an energy-efficient house.
	Students collaboratively discuss the characteristics, strengths, and weaknesses of electrical circuits.
	After the discussion, students present their findings to the class.
	Individually, students create a concept map with illustrations to explain electrical circuits.

4: Developing and Presenting Project Outcomes

This stage involves the process of developing and presenting the outcomes of projects previously conducted by students. It includes organizing and communicating findings derived from their investigations or completed projects. The activities related to developing and presenting the outcomes are summarized in Table 5.

Table 5. Developing and Presenting Project Outcomes

Stage 4	Learning Activities
Developing and Presenting Project Outcomes	Each group presents the results of their work in front of the class.

5: Analyzing and Evaluating the Problem-Solving Process

This stage involves the analysis and evaluation of the problem-solving process that students have undertaken. Students are expected to review the steps they have taken in resolving a problem and achieving their objectives. The evaluation process may

include reflection on the effectiveness of the proposed solutions, the challenges encountered, and the lessons learned for future improvement. The instructional activities for this stage are presented in Table 6.

Table 6. Analyzing and Evaluating the Problem-Solving Process

Stage 5	Learning Activities
Analyzing and Evaluating the Problem-Solving Process	Students, together with the teacher, discuss the outcomes of the tasks contained in the worksheet (LKPD). Each group receives feedback from the teacher regarding their submitted work.

Framework for the Assessment Instrument to Enhance Climate Change Literacy

The following table presents an assessment framework designed to evaluate students' literacy on climate change. It includes six core indicators reflecting students' understanding of climate change, which represent research-based learning outcomes in climate literacy.

Table 7. Climate Change Literacy Assessment Framework

Indicator	Sub-Indicator	Assessment Items
Basic Understanding of Climate Change	a. Understanding the basic concepts of climate science b. Identifying the factors that cause climate change c. Understanding the impacts of climate change on the environment and human life d. Identifying alternatives to mitigate the effects of climate change e. Understanding the basic concept of energy efficiency	a. Explain the definition of climate change. b. List the factors that contribute to climate change. c. Describe the impacts of climate change that you currently experience in your environment. d. What are some ways to mitigate the effects of climate change? e. What do you know about global warming?
Understanding the Causes of Climate Change	Understand human activities that contribute to climate change.	What human activities contribute to climate change?
Understanding Solutions to Address Climate Change	Identify and develop solutions to mitigate climate change.	What actions do you take to conserve energy?
Communication Skills Related to Climate Change	Effectively communicate climate change issues to relevant stakeholders.	What would you do if you saw someone using electricity during daylight hours unnecessarily?
Research Skills Related to Climate Change	Conduct research related to climate change issues.	Write an article about energy-saving practices in your local environment.
Awareness of the Impacts of Climate Change	Understand the environmental and societal impacts of climate change.	What actions should individuals take to help prevent further increases in global temperatures?

Follow-Up on the Development of Learning Instruments

In the development phase of the learning instruments, the 4D model proposed by Thiagarajan will be employed. This model consists of four systematic stages: Define, Design, Develop, and Disseminate.

1: First Stage: Define.

In this stage, researchers conduct observations and gather data to identify potential issues that may arise during the learning process. The primary objective is to establish and clarify the requirements of the instructional design by initiating an analysis of

the intended learning objectives. This stage involves five key analyses: preliminary analysis, learner analysis, task analysis, concept analysis, and the determination of instructional goals.

2: Second Stage: Design.

In the design stage, the researcher develops instructional tools that incorporate material on electrical circuits using the RBL-STEM (Relevant-Based Learning in Science, Technology, Engineering, and Mathematics) approach. This approach aims to enhance climate change literacy. This stage involves several essential steps, including:

a. Media Selection Phase: This phase focuses on identifying appropriate instructional media that align with the learning materials previously selected.

b. Format Selection Phase: This step involves determining the media format. The purpose is to design content, instructional strategies, and learning resources that effectively support the learning process.

c. Initial Design Phase: At this stage, all instructional components are assembled prior to testing. These components include the lesson plan (RPP), student worksheets (LKPD), and both pre-tests and post-tests.

d. Design Output Phase: The output from this design process serves as the initial draft of the instructional tools being developed.

3: Development Stage

The goal of this stage is to produce a finalized version of the instructional tools, refined based on feedback from subject-matter experts through a validation process. Subsequently, a trial implementation was conducted involving 18 sixth-grade students at SDN Banjarwungu 1, Sidoarjo.

4: Dissemination Stage

Once the product is declared valid and ready for use, the instructional materials can be implemented in other classes with similar topics, by different teachers, or even in different schools. The dissemination of these instructional tools may be conducted through journal publications, presentations at teacher working group seminars (KKG), and the sharing of best practices within professional learning communities.

DISCUSSION

This study employed a Research-Based Learning (RBL) model based on Science, Technology, Engineering, Arts, and Mathematics (STEAM) to address real-world challenges and to develop students' abilities to adapt to new and complex situations. In addition, the RBL-STEAM (Relevant-Based Learning) model is designed to provide students with essential skills and foster their creative thinking abilities. The student-centered learning process allows learners to discover ideas both independently and through interaction with their surroundings. The development of instructional tools using the RBL-STEM model has proven to be highly beneficial for enhancing students' climate change literacy, making it particularly relevant for everyday learning at the elementary school level, where students are still being shaped as members of the 21st-century generation. Climate change literacy serves as a valuable medium for fostering understanding and environmental awareness. Through this approach, students can comprehend the concept of climate change in a concrete manner by engaging in meaningful learning activities that directly integrate academic content with real-life climate change phenomena.

The learning materials were designed in alignment with the stages of RBL-STEM-based instruction, as reflected in research-oriented learning activities such as experiments involving the construction of energy-efficient house models. The developed materials included student worksheets (LKPD), instructional media, and Student Learning Outcome Tests (THPD), all tailored to meet the learning objectives and outcomes for sixth-grade elementary students.

To assess students' climate change literacy, pretest and posttest instruments were constructed, containing indicators specifically related to climate change literacy. These indicators served as benchmarks for evaluating students' understanding. The test items were designed to be open-ended in nature, aiming to foster students' critical thinking and problem-solving skills.

The development of RBL-STEAM-based learning materials, through the activity of designing energy-efficient houses, is expected to enhance students' climate change literacy in a comprehensive manner. This approach enables students to apply their knowledge and thinking skills in real-life contexts, thereby empowering them to actively contribute to addressing current and future climate change challenges.

CONCLUSION

This development research implemented the 4D model, which includes the stages of define, design, develop, and disseminate. The outcome of the research is a set of RBL-STEM-based learning materials aimed at enhancing students' climate change literacy. Through this learning activity, students created an energy-efficient house model using recycled Styrofoam waste as a medium. To assess students' climate change literacy, a literacy test was administered. This test was designed to measure not only students' understanding of climate change concepts but also their problem-solving skills related to environmental issues in their surroundings. The implementation of this learning model is expected to foster greater awareness and a deeper understanding among students regarding environmental preservation, thereby equipping them to contribute meaningfully to a more sustainable future for the planet.

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