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Development of Science Literacy Through Group Choice STEM-PjBL Projects Integrated with Matter State Changes

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Abstract: This research focuses on the development of students' science literacy in the topic of matter state changes at the primary school level. It utilizes Science, Technology, Engineering, and Mathematics - Project-Based Learning (STEM-PjBL) as a holistic integrative learning approach, supporting 21st-century skills. The meaningful learning design is crafted to help students understand the material while applying their understanding to a simple project appropriate for primary school students' cognitive levels. The study was conducted in a fifth-grade class at an educational unit in Tangerang City, Banten Province, Indonesia. Using a qualitative research method, data was collected through interviews, observations, reflective journals, and researchers' notes. The STEM-PjBL learning stages included reflection, research, discovery, application, and communication. The Shwartz assessment was developed as an instrument to evaluate students' science literacy abilities. The results show that implementing the STEM-PjBL approach promotes student-centered learning, builds group cooperation, is enjoyable, and develops students' science literacy. Students worked in groups on their chosen projects related to the topic of matter state changes. The average project score for each group received an A rating in completing the STEM-PjBL project. Interdisciplinary learning can encourage students to understand the characteristics and concepts of a theory and relate them to everyday life, thereby impacting their understanding and project development.

Keywords: Natural Science; Science Literacy; Primary School; STEM-PjBL

Introduction

Research data indicates that the process of teaching Natural Sciences in primary schools is often conducted through verbalism, meaning that teachers consistently lecture throughout the lesson (Khalida & Astawan, 2021; Hakim & Syofyan, 2017). The lecture method is indeed one of the easiest teaching approaches to practice across all subjects (Sultan & Tirtayasa, 2017). However, if the lecture method is used throughout science lessons, it can have detrimental effects on students, making them passive (Iqbal et al., 2021; Stehlik, 2018), stunting creativity (Sultan & Tirtayasa, 2017), causing boredom in following the lessons (Jannah et al., 2020), and leading to disinterest in science (Kusumawati, 2017).

Today's students will face more complex challenges as they grow up. Therefore, they need skills that will help them compete regionally and globally. From early childhood education onwards, Indonesian students must develop strong skills in collaboration, communication, creative thinking, critical thinking, compassion, and computation (Yolantia et al., 2021; Yalçın & Erden, 2021; Amin et al., 2022). These six skills are known as the 6C skills. Mastering these 21st-century skills is crucial for students to compete in the rapidly growing, borderless global era and to face future challenges (Rahmawati et al., 2022).

The Indonesian government has officially implemented the Merdeka Curriculum at all levels of formal education nationwide and recommends Project-Based Learning (PjBL) with a scientific, technological, engineering, and mathematical approach to be applied in teaching (Oktavia & Ridlo, 2020). STEM-PjBL, as a holistic integrative learning approach, aligns with the

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government's vision for meaningful learning. According to Rahmawati et al. (2022); Hebebci & Usta (2022); and Glancy & Moore (2013), STEM is a multidisciplinary learning approach that integrates four disciplines in a unified teaching method focused on solving real-life problems. STEM can be applied at all educational levels, from preschool (Margorini & Rini, 2019) to elementary school (Hasanah & Tsutaoka, 2019) and even post-doctoral levels (Ultay et al., 2020), with the content tailored to the student's cognitive development stages.

STEM becomes effective when integrated with project-based learning (PjBL), a learning model that involves complex tasks, problem-solving, and product design (Wan et al., 2022). STEM-PjBL encourages students to create contextual works involving problem-solving, demonstrating mastery of concepts from multiple subjects (Capraro & Slough, 2013). The combination of STEM and PjBL provides contextualization and authentic learning experiences, building meaningful learning that bridges classroom learning with the real world (Capraro & Jones, 2013) and offering solutions to human life problems (Lowrie et al., 2017) through project work. In summary, the STEM-PjBL approach is a project-based STEM learning model that integrates four subjects (science, technology, engineering, and mathematics) into a project to solve real-world problems, connecting students' understanding with the real world.

At the primary education level, several researchers have examined the implementation of STEM-PjBL. For example, Razali et al. (2022) and Baran et al. (2019) studied the impact of STEM-PjBL on students' cognition, Adriyawati et al. (2020) investigated alternative energy integrated with STEM-PjBL, and Davidi et al. (2021) explored STEM-PjBL in enhancing thinking skills. However, this study differs from previous research, focusing on the implementation of STEM-PjBL integrated with the matter state changes the topic, one of the subjects taught in fifth-grade science classes, to develop students' science literacy.

This research is significant because it aims to develop science literacy that has relevance to human life through a holistic integrative STEM-PjBL approach. The objective of this study is to describe the implementation of STEM-PjBL integrated with the matter state changes topic in science lessons to enhance fifth-grade students' science literacy through the projects they create.

Method

This research applies a qualitative research approach. A research method that will provide a detailed understanding of meaning, actions, and problems that have not been revealed (Cohen et al., 2018) allows researchers to dig into information in depth to find answers to the problems being studied (Creswell, 2012). The qualitative research carried out was an educational experiment (Hedegaard, 2012; Cohen et al., 2018; Utami et al., 2020). The role of the researcher, as well as a teacher, will directly intervene in the STEM-PjBL approach to students and explore the STEM-PjBL learning process integrated with changes in the shape of objects.

Research subject

This research was conducted in the 2023-2024 academic year in class V at one of the State Elementary Schools in Tangerang City, Indonesia. This research involved 39 students consisting of 14 men and 25 women. Research time is April – November 2023.

Research procedure

The research was carried out in 3 stages, namely, the preliminary stage, the implementation stage and the final stage. The flow of research implementation is depicted in Figure 1.

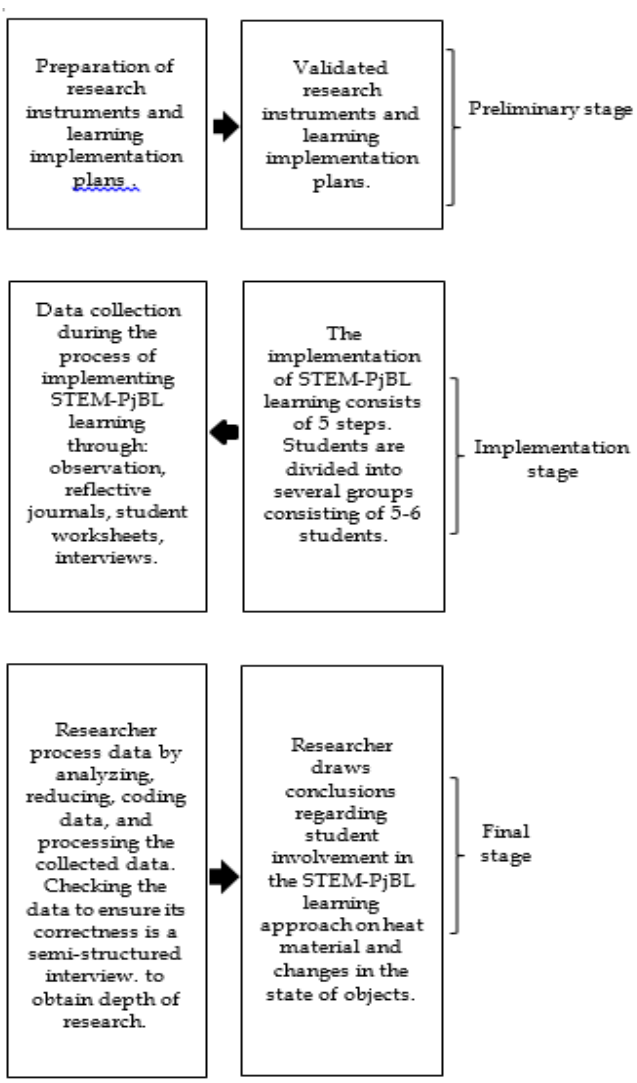

Figure 1. Research flow and data collection

The syntax of the STEM-PjBL learning model adopts the theory developed by (Laboy, 2015) consisting of five syntaxes, namely; reflection, research, discovery, application, and communication. The learning activities in question are explained in Figure 2.

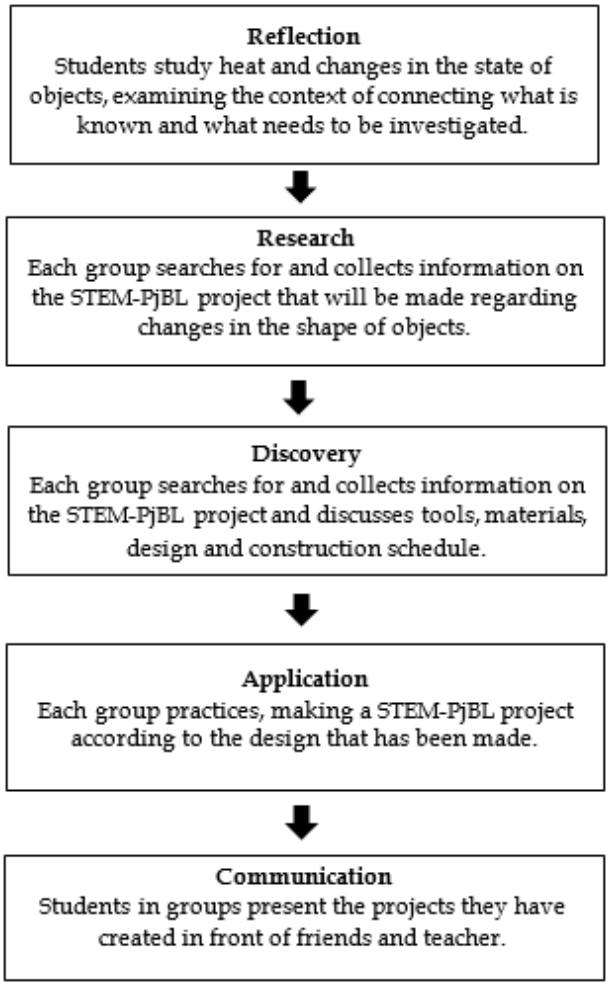

Figure 2. STEM-PjBL learning steps

Data Collection

Data collection in this qualitative research was conducted through semi-structured interviews, classroom observation, student reflective journals, researcher notes, and science literacy questions.

Semi-Structured Interviews

This process was carried out outside the classroom to gain a deeper understanding of the students' experiences with the integrated STEM-PjBL model focusing on heat and changes in the state of matter. The researcher conducted semi-structured interviews with the students outside of class hours. The issues discussed with the respondents were related to their experiences participating in the learning process using the STEM-PjBL approach integrated with changes in the state of matter. Below are examples of semi-structured interview questions:

> *- How was your experience participating in the STEM-PjBL lessons integrated with the topic of changes in the state of matter?*
> *- Do you think the STEM-PjBL approach made the material easier to understand?*

Classroom Observation

Classroom observations were conducted during the implementation of STEM-PjBL lessons integrated with the topic of changes in the state of matter. This observation was carried out by two observers from among the colleagues. Classroom observation is crucial to understanding the depth of the learning process in the classroom. The observers' task was to record every significant event observed while the researcher implemented the STEM-PjBL approach in the class. To facilitate the observers' and the researcher's tasks, the learning activities were recorded to be referenced if there were any uncertainties about events during the lesson. At the beginning of the lesson, the researcher posed stimulating questions expected to spark curiosity about the subject matter.

> *- Have you ever experienced or seen ice cream melting?*
> *- What causes ice cream to melt?*

Reflective Journal

Students wrote about their learning experiences at the end of each session. These learning experiences were gathered when they participated in learning activities with their teacher and peers. In their reflective journals, students wrote about their understanding of the material, the difficulties they encountered, and their ideas and thoughts during the lessons. Below is a common question that appeared in the reflective journal:

> *- What are your thoughts on the lesson you participated in today?*

Student Worksheets

At the end of the planned meetings outlined in the Learning Implementation Plan (RPP), students were given worksheets containing several questions that each student had to answer. The purpose of these worksheets was to determine the impact of the STEM-PjBL approach integrated with the topic of changes in the state of matter. The questions referred to a rubric assessing science skills related to changes in the state of matter. Below is an example of a question provided:

- Builders often use a hose filled with water when measuring the height of a wall being built to ensure it is not slanted. Builders use one of the properties of water, which property is meant...

Result and Discussion

This research focuses on developing students' science literacy skills using the STEM-PjBL approach integrated with the topic of changes in states of matter: solid, liquid, and gas. The learning implementation was related to the theoretical knowledge about the occurrence of changes in states of matter in students' daily lives, which they then applied in class. The goal was to develop students' cognitive, motor, and affective skills in a balanced manner. The learning activities followed the STEM-PjBL syntax (Laboy, 2015) shown in Figure 2: reflection, research, discovery, application, and communication, which were elaborated in the following activities:

Reflection

In the reflection stage, the researcher prepared the teaching media and materials to be provided to the students. The researcher delivered the lessons using a projector and provided students with a module on the topic of changes in states of matter. Students were encouraged to activate their cognitive and affective skills during the learning activities. The researcher presented slides on changes in the states of liquid, solid, and gas, starting with events that occur around the students. This approach aimed to facilitate students' understanding of the material.

Audio-visual-based lessons are particularly suitable for teaching abstract science concepts. Presenting the material through audio-visual means helps bring distant concepts closer, simplify difficult topics, and concretize abstract ideas, thus enhancing students' understanding. During the reflection activities, the researcher also posed stimulating questions related to students' daily observations of changes in states of matter. When lessons start with content already within students' prior knowledge, they are more likely to engage actively in the learning process.

The researcher used a projector as a visual aid to clarify the taught material, hoping to capture students' interest and enthusiasm for the lessons. During the first meeting, it was discovered that none of the students were familiar with the term STEM-PjBL. The researcher explained the STEM-PjBL approach in detail, outlining the learning stages to be conducted over the next seven sessions. An example of a STEM-PjBL project related to changes in states of matter, such as a simple humidifier, was presented. The researcher informed the students that each group would have to complete a STEM-PjBL project related to changes in states of matter, aside from the simple humidifier. This project was to be completed over the next seven sessions and presented to their classmates and teacher.

Students formed Focus Group Discussions (FGDs) consisting of 4-6 members to discuss, seek information, and work on the STEM-PjBL project related to changes in states of matter. The researcher allowed students to choose their group members without regard to gender, recommending they choose peers who lived nearby to facilitate group coordination in completing the STEM-PjBL project tasks.

Research

In the research stage, the researcher asked students to bring their devices to school. These devices were highly beneficial and reliable for finding the information needed for the subject matter and the project to be created. The researcher guided students in searching for the necessary information, starting with keywords such as "changes in states of matter," "liquid matter," "gaseous matter," "solid matter," and "STEM-PjBL." The researcher instructed each group to record and save any information deemed important to the topic of changes in states of matter.

Each group became busy using their devices to search for information on the internet and noting their significant and useful findings. At this stage, the learning process was student-centered, as students engaged in understanding, searching, analyzing, and examining the obtained information. When students are positioned as active learners, the learning process becomes more meaningful and valuable. The researcher moved from one group to another, asking about their findings and the challenges each group faced.

Some students shared their internet signals with peers who did not have internet packages.
(Researcher's notes, August 11, 2023)

The researcher assessed that the time allotted to search for information was complete, and then asked the entire group to summarize what they had obtained from the search results. The researcher asked each group randomly about their search and allowed students to ask questions about things they did not understand

Student 10: Can we replace the tissue and cotton with other media?
Teacher: Go ahead.
(Class observation, July 28, 2023)

Then the researcher asked the students to start thinking and searching for information from various sources such as the internet, YouTube, TikTok, Instagram, and others to come up with ideas for their

STEM-PjBL project related to the change in the state of matter. The researcher reminded them that the project must include elements of Science, Technology, Engineering, and Mathematics (STEM). Students admitted that finding a project idea for Project 2 was more challenging than for Project 1.

Student 6: What is the sand used for making the erupting volcano, sir?
Teacher: It depends on the volcano being made and the materials used. Whether using sand or other materials.
Student 39: Sir, can we use a vacuum cleaner for Project 2?
Teacher: No, because our project is related to heat and the change in the state of matter.
Student 7: What about a steamship, sir?
Teacher: Sure, just make sure to identify the STEM elements.
(Researcher's notes, August 11, 2023)

Discussions and Q&A sessions between group members and between students and the teacher occurred effectively. They actively sought inspiration for their projects, making the class lively. After each group searched and discussed, it was time for them to present their STEM-PjBL projects related to the change in the state of matter. Group 1 made a fruit ripening box, Group 2 created a volcano eruption, Group 3 made ice cream, Group 4 created another volcano eruption, Group 5 made a cooling fan, and Groups 6 and 7 made lava lamps.

Discovery

The researcher reviewed the material from the previous meeting about the change in the state of matter to help students recall and prepare for the next lesson. Then the researcher invited the students to do the necessary things to produce a good STEM-PjBL project, which included:

1. Groups designing the model to be made. The design would reveal the shape, size, and other details to guide them in working on the project.
2. Groups finding easily accessible, affordable materials available in their environment. Groups also created a work schedule to reach a consensus, ensuring the planned activities could run smoothly and the Project 2 assignment could be completed on time.

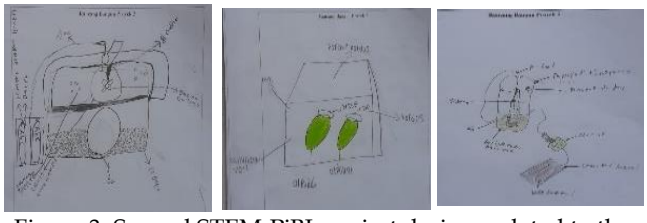

Figure 3. Several STEM-PjBL project designs related to the change in the state of matter

Students were somewhat confused about determining the STEM-PjBL project related to the change in the state of matter, especially when they tried to identify the STEM elements in the project they would create.
(Researcher's notes, August 11, 2023)

Student 2: Sir, can we color this picture?
Teacher: Sure, make a nice picture and color it to make it more attractive.
(Researcher's notes, August 11, 2023)

Each group divided tasks to find and gather the materials needed to create their second project. Students tried to find materials that were no longer in use, but if they couldn't find used materials, they would purchase them. For example, Group 5 agreed to make a simple cooling fan for their project. The group leader divided the tasks among the members to find the necessary materials and tools. One of the required tools was a dynamo, which they obtained from an old, unused toy car. When tested, the dynamo still worked well.

Application

At this stage, students worked in groups to apply the theories they had learned to create a STEM-PjBL project related to the change in the state of matter. They integrated science, technology, engineering, and mathematics into a project of their choice. Once all the materials and tools were gathered, the group began the project according to their design. Good communication, coordination, and cooperation were needed among the group members to build a solid team. This is where synchronization between theory and practical application occurred, requiring skills to create the project. Students discovered new things they hadn't expected during the implementation. They learned various techniques such as gluing different tools, assembling cardboard sheets into a box covered with aluminum foil, forming shapes from old newspapers without glue, making lids from boba cups using the same type of cups, and other techniques used to complete their projects.

Figure 4. The process of creating several STEM-PjBL projects related to the change in the state of matter

Student 39: Rolling the hose to reduce the oil's push to the surface of the plastic bottle.
Student 21: Innovating a plug-in lid for a plastic bottle by cutting, trimming, and gluing pieces from the same

bottle.
(Researcher's notes, August 19, 2023)

Group 4: Making a miniature volcano without using glue. They used small pieces of paper, wet them, and then shaped them into a mountain.
(Researcher's notes, August 12, 2023)

Teacher: Did you encounter any difficulties while working on the project?
Student 11: No.
Teacher: How come?
Student 11: Because we worked in a group.
(Interview, September 11, 2023)

Findings from this study show that the STEM-PjBL approach can provide a stronger positive stimulus for students' curiosity about discovering new things on their own, consistent with research by Rahmawati, Hadinugrahaningsih, et al. (2021). It also encourages students to think creatively, as stated by Sutaphan & Yuenyong (2023) and Hanif et al. (2019).

Figure 5. Results of a number of STEM-PjBL projects on materials changing the shape of objects.

Table 1. Project assessment results

Group	Project Name	Planning	STEM-PjBL Product	Report	Total value	Assessment Criteria
Pelud 1	Fruit ripening box	24	45	27	96	A
Pelud 2	Mount Merapi eruption	24	45	27	96	A
Pelud 3	Ice cream	24	45	27	96	A
Pelud 4	Mount Merapi eruption	24	43	27	94	A
Pelud 5	Simple cooling fan	22	43	25	90	A
Pelud 6	Lava lamp	22	42	23	87	B
Pelud 7	Lava lamp	22	42	25	89	B

Project assessment used a rubric focusing on three criteria: planning, the STEM-PjBL product, and the report. The project results showed an average grade of A. Each group successfully created a product based on their design and applied STEM principles as described in their reports.

Communication

The final stage of the STEM-PjBL syntax in this study is communication. At this stage, each group of students was given a maximum of 5 minutes to explain their completed project 2. The presentations included explanations of the materials, design, production procedures, and benefits of the project. The communication stage, in the form of presentations, is important for introducing students to developing communication skills, collaboration, and decision-making for the common good. Good communication skills are part of the 21st-century skills or 6C skills that students must have to face future challenges.

Figure 6. Group Presentations

Student 29: The presentation activities of each group made me confident and brave.
Student 3: The presentation activities made us braver and not afraid to speak in public, becoming confident in front of many people.
Student 6: Presenting the group's work results made me confident, not afraid of people.
(Student reflective journal, August 21, 2023)

Which project do you think is more beneficial, project 1 or project 2?
Student 14: Project 2 (making simple ice cream) because it's more beneficial for us, as it trains patience and hand speed.
Student 37: Project 2 (making a fruit ripening box) because it was fun and exciting to meet friends.
Student 39: Project 1 (simple humidifier) because it can cool the room.
Student 21: Project 1 (simple humidifier) because it is more beneficial by giving fragrance if scented.
(Student interview, August 21, 2023)

Student 16: Both project 1 (simple humidifier) and project 2 (simple cooling fan) are beneficial, sir.
(Student interview, August 25, 2023)

The application of the STEM-PjBL approach is known to have positive effects on students in solving problems they encounter, as shown in research by Muzana et al. (2021). Additionally, the STEM-PjBL approach can also develop students' creativity, as revealed in research by Siew & Ambo (2020), enhance students' skills (Baran M et al., 2021), and increase students' interest in learning science (Chen, C. S & Lin, 2019; Han et al., 2014). The many positive aspects of implementing the STEM-PjBL approach contribute to the affective, psychomotor, and cognitive development of students because STEM-PjBL presents holistic integrative science learning in the learning process.

Development of Students' Science Literacy

After completing all the STEM-PjBL learning syntaxes, the researcher needed to assess the students' science literacy skills related to the topic of changes in the state of matter. A series of questions were prepared to measure the development of students' science literacy concerning the characteristics, concepts, and context of changes in the state of matter in the real world, which are closely related to the present and future lives of humanity. The researcher used the theory by Shwartz et al. (2006) to measure students' science literacy skills on the topic of changes in the state of matter.

General Scientific Ideas

The first aspect assessed is general scientific ideas, used to gauge students' skills in conducting scientific investigations, understanding natural phenomena, and explaining events based on science (Shwartz et al., 2006). Efforts to develop students' general scientific idea skills include simple scientific investigations, explaining phenomena with learned theories, and drawing general conclusions about phenomena based on the scientific method. Admawati (2018) revealed in her research that the application of STEM-PjBL successfully ignited students' curiosity about the material being taught.

> *Vinegar is heavier than oil, so vinegar sits above the oil.*
> (Student reflective journal 39, August 11, 2023)

> *Baking soda is sodium bicarbonate and vinegar is a weak acid; mixing these two chemicals produces carbon dioxide that tries to escape from the artificial volcano.*
> (Student reflective journal 29, August 11, 2023)

Kurt & Benzer (2020) and Adriyawati et al. (2020) concluded in their research that students' problem-solving skills in real life can be developed through a transdisciplinary project-based learning approach. The findings of this study align with their conclusions. This was evident in students when they were able to conduct simple scientific investigations of real-world events they encountered in everyday life.

Characteristics of Science

Students delve into knowledge within the Natural Sciences discipline on the topic of changes in the state of matter, exploring its properties and characteristics. The topic of changes in the state of matter is very close to students' daily lives. According to Engineers (2019), studying the characteristics of Natural Sciences, which is a body of knowledge, provides students with a comprehensive understanding of nature and life, explaining and predicting based on experiments and evidence.

> *A reaction occurs when water and oil are mixed in one container; they cannot combine.*
> (Student reflective journal, August 11, 2023)

> *The chemical reaction between vinegar and baking soda produces carbon dioxide (CO2), and the gas pressure is affected by the amount of vinegar and baking soda reacting.*
> (Student reflective journal 3, August 11, 2023)

> *Aluminum foil has properties that can prevent air from entering or exiting, which I think will help speed up fruit ripening.*
> (Student reflective journal 33, August 11, 2023)

The results above show that students understand the material well on changes in the state of matter. This was evident when students could correctly answer the teacher's oral questions. This proves that the application of STEM-PjBL offers a deep and meaningful learning process (Winarni et al., 2022) for students. Meaningful learning occurs when students become the subjects of learning rather than the opposite.

Science in Context

The development of science skills in context among students on the topic of changes in the state of matter can be identified when they understand the taught theory as it applies to real-life contexts, practice the learned science in daily life, and use it for the sustainability of human life.

> *Not only Fanta can produce a foam eruption when it meets Mentos; other carbonated drinks can do the same.*
> (Student reflective journal 36, August 16, 2023)

> *No air comes out of the holes when the propeller spins, but when small holes are made in the top of the container, the wind is felt.*

(Student reflective journal 24, August 16, 2023)
The positive and negative positions on the dynamo affect the wind produced by the propeller. If installed incorrectly, the wind will not be felt.
(Student reflective journal 34, August 16, 2023)

Based on the information above, it can be concluded that students' scientific literacy abilities in the context of changes in the form of objects continue to improve. Through this information, it is known that students can grasp the relevance of Natural Science in daily activities, where science bridges the ease with which humans can carry out every activity, making something that is difficult to do easy. This is by research conducted by Sigit et al (2022) which states that contextual learning which combines several subjects, and then links the real world with students' understanding can provide new understanding to students. This is reinforced by the opinion that the STEM-PjBL approach supports meaningful learning processes using contextual principles (Tseng et al 2013: Capraro & Jones, 2013).

Higher Order Thinking Ability

High Order Thinking Skills (HOTS) or what is known as high-order thinking skills are very important for students to have. Students' HOTS abilities need to continue to be cultivated so that they can think at a higher level. High-level thinking is a person's skill in identifying, understanding, being logical in thinking, and being able to accommodate knowledge in new forms, argue, make conclusions, and solve problems through scientific evidence and a scientific approach (Miedijensky et al., 2021). According to Miri et al (2007) when students ask questions regarding topics they do not yet understand, that is also part of higher-order thinking skills. The development of students' high-level thinking skills in this research can be observed when students can analyze, and conclude something based on the facts obtained, and have the courage to ask questions and express opinions.

A fruit ripening box which is coated and tightly closed with aluminum foil and dried in the sun for several hours, turns out to be able to make avocados which have been cut at the bottom and then attached with a tissue, to ripen more quickly and well. Matures faster in 3 days. Compared to avocados which are treated the same but are not put in the fruit ripening box. And 1 avocado with which nothing was done.
(Student interview 37, 16 August 2023)
Student 2, what do you mean by the property of water being almost incompressible, sir?
Student 29, sir, what is the meaning of medium density of water?
(Class observation, July 21, 2023)

Several data obtained in the ongoing learning process illustrate that students can build knowledge and develop high-level thinking skills. High-level thinking abilities emerge when students are not afraid to ask and analyze questions, this is by research (Sole & Anggraeni, 2020). Then the development of students' HOTS skills can also be seen from several events such as the results of observations by observers and student reflection journals, this is by research conducted (Rahmawati et al., 2021). The facts seen during research in the learning process show that the STEM-PjBL approach is able to develop student's skills in critical thinking. This is in accordance with research conducted (Kurniahtunnisa et al., 2023).

Affective

During the learning process, students' attitudes showed interest, curiosity, group collaboration at school and outside school, and excitement towards the STEM-PjBL approach carried out by researchers. Students enjoy working on assignments in groups, are proud when projects 1 and 2 function well, all of this is summarized as follows:

Which project do you think is easier to make, project 1 or project 2?
Project 1 simple air humidifier
The reason?
Because it's easy to find tools and ingredients, making it is also easy.
(Student reflective journal 15, 21 August 2023)
In your opinion, is there any benefit to Project 1?
Some tools can be made to humidify the room and smell the room.
(Student interview 26, November 21, 2023)
When working on a simple humidifier project, have you encountered any difficulties?
No, because we discussed how to make it and did it together.
(Student interview 32, September 19, 2023)

Students have a good affective attitude in responding to climate change, which reflects an understanding of the importance of preserving the environment for future generations. As students, they can do small things to reduce global warming, to preserve nature.

As a student, what should you do to reduce global warming?
Don't throw rubbish carelessly, don't burn forests, use water sparingly, save electricity, and use bicycles.
(Student interview 28, November 14, 2023)
Plant trees, save electricity, save water, save on household needs, use public transportation, and use

electric motorbikes and bicycles.
(Student interview 16, November 21, 2023)

Information obtained from students' reflective journals and interviews confirms and mutually reinforces that the STEM-PjBL approach in the classroom is able to provide fun, student-centered learning and is following research findings conducted by Rahmawati, Hadinugrahaningsih, et al (2021). Group STEM-PjBL learning activities make difficult billing projects easy. By working in groups, a sense of mutual care, leadership, and responsibility for the results that must be completed will grow, according to research (Sahin & Top, 2015).

Conclusion

The results of the research show that the integrated application of STEM-PjBL material on changes in the shape of objects in class V can provide learning that can develop students' scientific literacy on the topic of changes in the shape of objects. Students as learning subjects are actively involved in every learning activity carried out. As a group, they tried to find information from various sources to create a STEM-PjBL project related to material changing the shape of objects. Information search activities and direct practice carried out when making projects certainly increase their knowledge of scientific literacy to develop from before. Pelud 1 makes a fruit ripening box (avocado), Pelud 2 makes a volcanic eruption made from vinegar – baking soda, Pelud 3 makes a simple ice cream, Pelud 4 makes a volcanic eruption made from fizzy drinks and mentos, Pelud 5 makes a simple cooling fan, Pelud 6 makes lava bubbles, Pelud 7 also makes lava lamps. The activities carried out can develop students' abilities related to aspects of general scientific ideas, aspects of science in context, aspects of high-level thinking, and affective aspects related to changes in the form of objects. The challenges that researchers found were providing an understanding of STEM projects, the cognitive level of fifth-grade elementary school students, and limited research time. In Natural Science lessons, there is a lot of material that can be explored further using the STEM-PjBL approach. So that future researchers have a great opportunity to research STEM-PjBL, especially at the basic education level.

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Author Contributions
All authors had a role in preparing the draft until this article was completed. RS is responsible for preparing research instruments and collecting data. YR carried out instrument development and research design. ADU plays a role in research data analysis studies.

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