Developing an Understanding of Science Concepts in Elementary Schools Through a Deep Learning Approach (An Analysis of Learning Challenges in Improving Conceptual Understanding)

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ABSTRACT
Deep learning encourages students to connect knowledge to real-life contexts and develop critical and reflective thinking skills. This research aims to raise awareness for all parties, especially academics, of the importance of science learning in understanding science concepts. This research was conducted through a literature review. This literature review involved reviewing relevant concepts and theories based on available literature, specifically articles published in scientific journals containing theories related to understanding science concepts in elementary school through a deep learning approach. Data collection was conducted through journal searches and scientific sources in electronic media, such as digital libraries and the internet. The study's results indicate that the deep learning approach enhances the quality of learning. Its application includes: First, learning about living things and the environment in Madrasah Ibtidaiyah (MI) not only builds understanding but also shapes students' attitudes towards the environment. Second, there is great potential for this approach to help MI students understand the concept of energy and its changes in depth. Third, the nature and changes in the state of matter play a crucial role in building students' basic understanding of the natural phenomena around them. Fourth, learning about the earth and the universe becomes more meaningful and not just a matter of memorizing the material.

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INTRODUCTION

The teaching and learning activities of the Natural Sciences (IPA) at Madrasah Ibtidaiyah (MI) play an important part in developing students' understanding of nature and encouraging an attitude of environmental responsibility from an early age. Science not only provides a method of conveying scientific ideas and evidence but also as a tool to foster critical thinking abilities, scientific perspectives, and students' awareness of the natural phenomena.[1] In reality, MI often emphasizes cognitive understanding of the material and relies heavily on memorization in science learning. The teaching and learning process tends to be dominated by lecture methods and the use of textbooks, so students are less actively

[1] Fia Alifah Putri et al., "Pendekatan Pembelajaran IPA Berbasis Sains Di Pendidikan Dasar," *SITTAH: Journal of Primary Education* 5, no. 1 (2024): 306-312, https://doi.org/10.30762/sittah.v5i1.3280.

involved in the learning process. This condition causes students' understanding of science concepts to be superficial and less meaningful, and it has not yet been able to encourage changes in students' thinking and behavior toward the environment. However, science education should be able to find connections between concepts and students' real-life experiences so that the knowledge gained can be applied in everyday life.

The first material in science learning at MI is living entities and the environment. This material is close to the students' daily lives and serves as the foundation for understanding ecosystem balance. This material is important because issues related to living things and the environment have become a focal point, considering the current environmental conditions that face various challenges, such as environmental pollution, suboptimal waste management, and ecosystem damage due to human activities.[2] These environmental issues are not only global in nature but can also be found in the surroundings of students, including their school and residential areas.[3] Therefore, early environmental education through science learning in MI has become an urgent need to shape a generation that has awareness and responsibility toward the environment.

Science learning about living entities and the environment has great potential in fostering students' environmental awareness when presented through the right approach. Meaningful learning must be able to encourage students to understand the relationship between living things and their environment in depth, not just memorizing concepts. To achieve this goal, an approach to the learning process is needed that emphasizes deep understanding, active student engagement, and reflection on learning experiences.

The second material in the teaching and learning activities of Natural Sciences at the elementary level is an important foundation in building early science understanding such the concept of energy and its transformations, which are often abstract and difficult for lower-grade students, including Madrasah Ibtidaiyah students. Energy is a fundamental concept directly related to natural phenomena and daily life, such as electrical energy, light energy, and the transformation of energy from one form to another. However, conventional learning often centers around the teacher and rote memorization, which causes students to be less able to understand concepts in depth. The Deep Learning approach, in the pedagogical sense, is not merely artificial intelligence, but an approach in the learning process that encourages meaningful, mindful, and joyful conceptual understanding, becoming one of the innovative strategies to address this challenge.[4]

The third material that is beneficial for elementary school students within the scope of natural sciences is still basic material about the universe, matter, and the changes that occur in the world around them. One of the important topics in IPA is the change of state. The change of matter is explained as a substance undergoing a transformation from one form of matter to another. For example, we often encounter changes from solid to liquid or from liquid to gas.

However, in practice, science learning in MI is still often fixated on memorizing concepts without truly understanding them in depth. Students tend to know the terms, but are not yet able to explain the process of changes in the form of objects conceptually and

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[2] Siti Mastiyah, "Pembelajaran IPA Berbasis Lingkungan Sekitar Dalam Mengembangkan Keterampilan Proses Siswa SD/MI," *Ta'diban: Journal of Islamic Education* 6, no. 1 (2025): 39–45, https://www.academia.edu/download/76897686/1620420003_BAB_20I_V_DAFTAR_20PUSTAKA.pdf.

[3] Susi Dwi Pebrianti, Ernita Aulia, and Muhamad Arif Mahdiannur, "Penggunaan Lingkungan Sekitar Sebagai Sumber Belajar IPA Pada Materi Ekosistem," *Central Publisher* 2, no. 12 (2024): 3005-3011.

[4] Shelly Mei Fransiska and Muhammad Nuruddin, "*Deep Learning* Based Interactive Edpuzzle Improves Science Learning Outcomes on Energy in Elementary School Students," *Tunas: Jurnal Pendidikan Guru Sekolah Dasar* 11, no. 1 (2025): 6–12, https://doi.org/10.33084/tunas.v11i1.11563.

applicatively.[5] This leads to a low understanding of concepts and a lack of critical thinking skills among students. The Deep Learning approach in education is coming up a solution to address the issues.[6] This approach emphasizes meaningful teaching and learning activities, deep understanding of concepts, relationships between concepts, and the application of knowledge of real life.[7] By Using the Deep Learning approach hoped that MI students will be able to memorize, understand the concept of the properties and changes of matter more comprehensively.

The fourth topic in the teaching and learning activities of Natural Sciences at Madrasah Ibtidaiyah (MI) has a strategic function to build students' understanding of natural phenomena. The unit on Earth and the universe is a crucial component of Science, as it contains abstract concepts such as the rotation of the earth, the shape of the solar system, and the relationship between celestial bodies and daily life.

Several studies at the Elementary School (SD) level indicate that implementing the Deep Learning approach can enhance conceptual understanding, student engagement, and critical thinking in general Science education. For example, a study analyzing Science education using the Deep Learning approach demonstrated that this approach fosters stronger conceptual understanding compared to conventional methods. Thus, the application of Deep Learning in science teaching and learning activities on Earth and the universe at Islamic elementary schools is considered important to help students understand concepts in a more meaningful and contextual way. This essay discusses the basic concepts of the Deep Learning approach and its relevance to the science learning process at Islamic elementary schools, particularly regarding Earth and the universe.

Generally, science instruction relies heavily on rote memorization, making it difficult for students to grasp concepts deeply. To address this issue, teachers should ideally adopt teaching approaches that not only convey information but also encourage students to think critically, meaningfully, and reflectively. Teachers should adopt learning strategies that provide deep learning experiences, emphasize conceptual understanding, and connect knowledge to students' real-world experiences. The Deep Learning approach can help students develop a more comprehensive understanding of science material, particularly.

The Deep Learning approach in the context of education is understood as a learning process that emphasizes deep, meaningful, and sustainable conceptual understanding. Deep Learning encourages students to connect knowledge with real-life contexts and develop critical and reflective thinking skills.[8] This approach is relevant to be applied in science learning at MI because it aligns with the characteristics of the students and the contextual learning needs. Through this research, the researcher hopes to raise awareness of the importance of science education regarding conceptual understanding of science material through the Deep Learning approach, which is expected to foster students' environmental awareness in a sustainable manner.

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[5] Nurul Aulia et al., "Konsep Dan Implementasi Pendekatan *Deep Learning* Di Sekolah Dasar," *Pendas : Jurnal Ilmiah Pendidikan Dasar* 10, no. 2 (2025): 1661-1672.

[6] Alya Fitriani and Santiani, "Analisis Literatur: Pendekatan Pembelajaran *Deep Learning* Dalam Pendidikan," *JINU:Jurnal Ilmiah Nusantara* 2, no. 3 (2025): 50–57, https://doi.org/10.61722/jinu.v2i3.4357.

[7] Neti Herwati, *Penerapan Supervisi Kolaboratif Guru IPA Dalam Meningkatkan Kompetensi Profesional*, ed. Nurhabibah, 1st ed. (Sukoharjo: Oase Pustaka, 2022): 12-14, https://www.google.co.id/books/edition/SUPERVISI_AKADEMIK_DALAM_MENINGKATKAN_KO/ivzSEAAAQBAJ?hl=en&gbpv=1&dq=Penerapan+supervisi+kolaboratif+guru+IPA+dalam+meningkatkan+kompetensi+profesional+/+penulis,+Neti+Herwati,+S.Pd.,+M.M.Pd.+%3B+penyunting,+Nurhabi.

[8] Muhammad Feri et al., "Implementing *Deep Learning* Approaches in Primary Education: A Literature Review," *Jurnal VARIDIKA* 37, no. 1 (2025): 178–94, https://doi.org/10.23917/varidika.v37i2.12151.

Research on the topic of deep learning is relatively new, which means that significant contributions from other researchers are needed to help raise awareness and disseminate understanding among elementary school teachers and stakeholders regarding the importance of a learning process that leaves a lasting impression on students. For researchers, Deep Learning and science serve as the foundation for a new approach to initiate further research, particularly in improving the quality of teaching and learning in current elementary education.

RESEARCH METHOD

The purpose of this research is to understand the importance of of science education regarding the conceptual understanding of science material through the Deep Learning approach, which is expected to foster students' environmental awareness in a sustainable manner. This research was conducted using a literature review as the chosen research approach. A literature review, also known as a literature study, is a structured activity carried out to collect, process, and conclude data using specific methods to answer questions in the research.[9] In literature study research, data collection is carried out by reviewing various relevant written sources, such as reference books, similar previous research results, scientific articles, notes, and journals related to the topic being studied.[10] This research method is expected to provide a deeper examination of the understanding of science concepts through the analysis of relevant approaches, specifically using the Deep Learning approach; naturally, this analysis is inspired by various official literature from diverse sources.

The literature review in this research is conducted by examining relevant concepts and theories based on the available literature, particularly articles published in scientific journals from 2022 to 2025, which contain theories related to the understanding of MI science concepts through a Deep Learning approach. The object of this research is the concepts of science and Deep Learning, while the subjects of the research are focused on upper-grade elementary school students, as the researchers' concentration so far has been on basic education.

Data collection was conducted throuh the search for journals and scientific sources on electronic media, such as digital libraries and the internet. The keywords used in the literature search process are "Deep Learning approach and IPA concept." Thus, the data sources in this study were derived from books, scientific journals, and websites relevant to the formulated research problem. The data collection technique used was documentation, specifically the collection of data through four types of records: books, papers, articles, journals, and other written documents aligned with the research focus.[11] Next, the collected data is processed using content analysis techniques. Content analysis is carried out thru the process of selecting, comparing, grouping, combining, and interpreting various concepts and research findings until a relevant and comprehensive understanding is obtained in accordance with the research objectives.

In summary, the research data synthesis stages follow these steps:

1. The researcher critically reads all the literature on Deep Learning and IPA that has been collected, then extracts data by noting concepts, themes, and findings relevant to the focus of this research, which is the importance of IPA learning related to the understanding of IPA material concepts thru the Deep Learning approach.

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[9] Irwansyah, *Tipologi Literature Review Dalam Metode Penelitian*, ed. Larasati Gustia Ayopma, 1st ed. (Solok: Mitra Cendekia Media, 2024). 52-55.

[10] Agus, Al Ikhsan et al., *Studi Literatur* 1, vol. 01 (Purbalingga: Eureka Media Aksara, 2023)., 217.

[11] Irwansyah, *Tipologi Literature Review Dalam Metode Penelitian*., 58-61.

2. The researcher identified connections between sources by mapping findings that were consistent, contradictory, or complementary regarding Deep Learning and science education.
3. The researcher interprets and analyzes the similarities and differences among the literature so that the researcher can provide an original interpretation to answer the research questions, one of which is why the Deep Learning approach is important to apply in MI science education.
4. The researcher develops new ideas based on a synthesis of the various literature to support a central argument: the importance of understanding elementary science concepts through the Deep Learning approach in enhancing conceptual understanding.

RESULTS AND DISCUSSION

The term Deep Learning was initially introduced as evidence of the importance of a learning approach that focuses on a comprehensive understanding of meaning and the relevance between concepts. Therefore, this learning model emphasizes the development of a deeper understanding of the subject matter thru comprehensive learning experiences. This means that students' learning experiences not only involve cognitive aspects but also emotional aspects. This approach aims to change the old learning paradigm that tends to emphasize memorization and repetition of information, but more than that, the learning process is expected to be more constructive and reflective. This transformation allows students not only to master the content of learning but also to develop critical thinking skills, creativity, and problem-solving abilities.

Thus, deep learning not only prepares students for academic tests but also equips student with the skills needed to face the challenges of the real world in the future. The definition of Deep Learning as an approach that emphasizes conceptual understanding and the critical implementation of knowledge. It is quite surprising that there is a theory stating that the application of the Deep Learning approach has an effect size of 0.69, which identifies a significant positive impact on students' learning achievements. In agreement with the statement, deep learning is defined as a learning process that requires active student engagement in exploring and applying fundamental ideas, which will assist students develop their capacity for critical thinking and enable to face real-life obstacles.[12] More specifically, the main elements of deep learning are as follows:

First, meaningful learning. Meaningful learning is key to deep learning. Meaningful learning enables students to understand learning content in a deep and comprehensive way. This process involves integrating new information with the students' existing knowledge framework. Essentially, the application of meaningful learning in educational practice involves various teaching strategies that motivate students to construct their understanding; additionally, teachers design teaching and learning activities that enable students to achieve maximum learning outcomes. Second, Mindful Learning. Mindful learning ranks second in importance and plays a crucial role in enhancing students' awareness and active participation in teaching and learning activities. This method helps students become sensitive and reflective learners. Mindful learning is not just about focus but also encompasses the enhancement of metacognitive awareness. Metacognitive awareness is believed to help students understand and manage their learning processes. Third, Joyful Learning. Learning with a sense of joy adds a crucial emotional dimension to the educational process. This method combines various key components of the learning process such as engagement,

[12] Eka Mega Purnama & Zulfadewina, "Pengaruh Penerapan Kontekstual Terhadap Hasil Belajar IPA : Konsep Perubahan Wujud Benda Kelas IV SDIT Insan Madani Jakarta," *Journal on Education* 07, no. 01 (2024): 509-513.

creativity, effectiveness, and enjoyment. Creating a joyful learning environment does not detract from the essence of learning itself; rather, a joyful learning experience enhances its effectiveness.[13]

Research in educational psychology identifies several fundamental characteristics of Deep Learning. Firstly, Students actively pursue meaning and comprehension from the material they study, rather than passively absorbing information. Secondly, students associate new concepts with their prior knowledge, creating a cohesive knowledge schema. Third, students employ higher-order thinking strategies, specifically analysis, synthesis, and evaluation. Knowledge is acquired not merely through memorization or simple comprehension. Fourth, students are able to apply the knowledge they have learned to different contexts or situations. This demonstrates flexibility and depth of thinking.

Besides cognitive elements, Deep Learning involves students' affective and motivational aspects. Students learning through this approach generally possess strong intrinsic motivation a drive to learn that originates from within, rather than solely due to the pressure of grades or rewards. They experience satisfaction and joy when successfully grasping difficult concepts or solving problems, so they do not easily give up and have a desire to continue learning, both within and outside the school environment.

The deep learning approach serves as an alternative for creating more meaningful and in-depth learning. Deep learning in an educational context emphasises a comprehensive understanding of concepts, active student engagement in the learning process, and reflection on past learning experiences. In this approach, students do not merely learn to acquire information but are guided to understand, connect, and apply that knowledge in various real-world situations.[14] The *deep learning* approach aligns closely with the characteristics of science education, which requires students to be active in scientific processes such as observing, asking questions, experimenting, and drawing conclusions.

The Concept of Living Organisms and the Environment Using a *Deep Learning* Approach

The teaching and learning activities of science in elementary schools are designed to provide meaningful learning experiences so that students can understand nature scientifically while also fostering a caring attitude toward their environment. The process of learning science is not solely directed at achieving learning outcomes in the form of grades or evaluation scores, but also emphasizes the process of how students acquire, build, and construct knowledge thru real and meaningful learning activities[15] Therefore, science learning in MI needs to be adjusted to the cognitive development aspects of students who are at the concrete operational stage, where students will find it easier to understand concepts if the learning is directly related to objects, events, and phenomena they encounter in their daily lives.

The subject of living organisms and the environment is one of the core topics that play a crucial role in science teaching and learning at MI because it is closely tied to students' real-life experiences. This subject covers the identification of the characteristics of living organisms, their basic needs, habitats, and the reciprocal relationships between living organisms and their environments. Understanding these concepts serves as the foundational basis for students to grasp the concepts of ecosystems, environmental balance, and the

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[13] Muhammad Feri et al, "Implementing *Deep Learning* Approaches in Primary Education: A Literature Review.", 178-194.

[14] Siti Mastiyah, "Pembelajaran IPA Berbasis Lingkungan Sekitar Dalam Mengembangkan Keterampilan Proses Siswa SD/MI.", 39-45.

[15] Nurul Aulia et al., "Konsep Dan Implementasi Pendekatan *Deep Learning* Di Sekolah Dasar.", 1661-1672.

sustainability of life on Earth. If students can understand that every living organism is interdependent with one another and dependent on its environment, awareness of the need to protect and preserve the environment will gradually develop from an early age.

Unfortunately, in practice, the teaching of living organisms and environmental material in MI is often delivered theoretically and centered solely on the teacher. Learning that tends to emphasize the verbal delivery of concepts without involving direct experiences causes students to struggle in connecting the subject matter with the environmental issues they face around them. As a result, science education has not yet fully had a tangible impact on the formation of environmental awareness in the students themselves. This condition indicates the need for a learning approach that can connect science concepts with the students' daily life realities in a more contextual manner, so that students can emulate and practice them in a real and direct way in their daily lives.

In the process of learning science about living things and the environment, the Deep Learning approach can be implemented thru the utilization of the surrounding environment as a learning resource. The school environment as well as the students' residential environment can be used as learning media to conduct observations of living things, environmental conditions, and various existing environmental issues. This environment-based learning provides students with the opportunity to gain direct learning experiences so that science concepts can be understood more concretely and meaningfully.[16] Through observation, discussion, and reflection activities, students not only understand the concepts but also are able to relate them to real life.

In addition, the Deep Learning approach encourages students to develop critical thinking skills regarding environmental issues in their surroundings. Students can be encouraged to identify simple environmental problems, such as the presence of trash in the school environment, the lack of green spaces, or the condition of polluted water. With the guidance of teachers, students can discuss the causes and impacts of these problems and formulate simple solutions that they can implement according to their abilities and age.[17] This process helps students understand the cause-and-effect relationship between human activities and environmental conditions.

Through learning that emphasizes deep understanding, students' environmental awareness can develop naturally. Environmental awareness is not merely taught as a normative moral value but is cultivated through students' learning experiences and their understanding of the importance of preserving the environment. When students understand the impact of human behavior on the environment, they will be more motivated to act with care, take responsibility, and actively participate in protecting their surroundings.[18]

Character values, including environmental care, can be integrated into science learning thru contextual and meaningful learning activities. Furthermore, the Deep Learning approach similar to efforts to strengthen character education in Madrasah Ibtidaiyah. Learning that involves real experiences, discussions, and reflections helps students internalize these character values so that they can be applied in daily life. Thus, science learning is not only oriented toward concept mastery but also toward the holistic character formation of students, meaning that learning is not just about theory but also brings deep significance to students.

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[16] Pebrianti Aulia, and Mahdiannur, "Penggunaan Lingkungan Sekitar Sebagai Sumber Belajar IPA Pada Materi Ekosistem.", *Jurnal Central Publisher:* 2, no. 12 (2024): 3005-3011.

[17] Siti Mastiyah. "Pembelajaran IPA Berbasis Lingkungan Sekitar Dalam Mengembangkan Keterampilan Proses Siswa SD/MI", 39-45

[18] Mia Septiani Hasibuan and Sapri, "Pendidikan Karakter Peduli Lingkungan Melalui Pembelajaran Ilmu Pengetahuan Alam (IPA) Di Madrasah Ibtidaiyah," *Jurnal EDUCATIO: Jurnal Pendidikan Indonesia* 9, no. 2 (2023): 700, https://doi.org/10.29210/1202323151.

In addition, the application of the Deep Learning approach supports 21st-century learning that emphasizes critical thinking skills, problem-solving, creativity, and global awareness. Environmental issues are global issues that require attention and awareness from an early age. Therefore, science learning thru the Deep Learning approach can be a powerful tool to foster environmental awareness among MI students in accordance with their cognitive and social development levels.[19]

Thus, the application of the *Deep Learning* approach in science teaching and learning activities regarding living organisms and the environment in Madrasah Ibtidaiyah holds great potential for fostering environmental awareness among students. Meaningful, tangible, and experience-based learning activities not only help students understand science concepts more comprehensively but also encourage them to internalize the values of care and responsibility toward the environment from an early age.

The Concept of Energy and Its Transformations Using the Deep Learning Approach

Energy material covers the definition of energy, forms of energy (such as kinetic energy, potential energy, electrical energy, thermal energy, light energy, and sound energy), as well as the transformation of energy from one form to another. Elementary Madrasah students' understanding of these concepts needs to be built through active, contextual learning interactions that are closely tied to students' daily experiences.

Learning about energy in MI usually begins with the introduction of various energy sources found around the students, such as the sun, food, batteries, and fuel. Next, students are invited to observe and identify various forms of energy that can be seen in their daily lives. Examples that we can easily find include light energy from the sun, kinetic energy from moving vehicles, thermal energy from fire, and sound energy produced by musical instruments. This approach helps students understand the concept of energy in a concrete and meaningful way.

Evidence shows that using video media in learning activities is effective in strengthening elementary students' understanding of energy concepts and energy transformations. Such visual media not only increase students' interest in learning but can also encourage active engagement through the visualization of abstract scientific phenomena.[20] Furthermore, studies on the use of interactive simulation media such as PhET also prove that interactive visual media can help students understand energy transformation more clearly and concretely thru safe and engaging virtual experiments.[21]

In education, Deep Learning refers to a learning approach that encourages students to achieve deep and meaningful understanding, rather than merely memorizing surface-level information. This approach is contrasted with rote learning, which only emphasizes remembering and reproducing information without strong conceptual understanding. Thru deep learning, students are expected to fully comprehend concepts, relate them to real-life experiences, and apply them in various life contexts.

The Deep Learning approach in science education emphasizes a learning process that leads students not only to know scientific facts but also to truly understand, apply, and integrate the knowledge they acquire. This approach focuses on three key points, namely meaningful learning, deep learning, and finally, enjoyable learning. The application of this

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[19] Pebrianti Aulia, and Mahdiannur, "Penggunaan Lingkungan Sekitar Sebagai Sumber Belajar IPA Pada Materi Ekosistem.", 41-45.

[20] Yuliani Sepe Wangge et al., "Penerapan Media Video Pembelajaran Dalam Penguatan Konsep Energi Dan Perubahannya Di Sekolah Dasar," *Jurnal GEMBIRA (Pengabdian Kepada Masyarakat)* 3, no. 3 (2025): 1270-1277.

[21] Mia Septiani Hasibuan and Sapri, "Pendidikan Karakter Peduli Lingkungan Melalui Pembelajaran Ilmu Pengetahuan Alam (IPA) Di Madrasah Ibtidaiyah.", 700.

learning process is expected to create a more memorable, reflective, and student-centered learning experience.[22] To implement deep learning in teaching energy at MI, teachers need to plan carefully. Here are some methods that can be implemented:

First, Phenomenon-Based Learning (Real Events)

The teacher can start the lesson by showing interesting things related to energy. For example: A toy that can move on its own after winding its spring/key, a solar panel that can light up a lamp. That is a simple experiment about energy transformation. This real activity makes the lesson feel more tangible and easier for students to understand. After that, the teacher helps the students to ask questions. For example: "Where does this toy get its power to move?" "How can solar panels generate electricity?" "Why do fast-moving objects feel hot when they stop?" These questions then become the basis for students to conduct investigations, whether thru experiments, observations, or reading simple books.

Second, using interactive and visual media

Such as educational videos, interactive simulations, or Edpuzzle to explain energy concepts in a tangible and contextual way.

Third, continuous assessment

To ensure students truly understand (rather than just memorize), teachers need to conduct appropriate assessments. When giving grades or feedback, teachers focus on whether students truly grasp the concept and encourage them to think more deeply:

First, open-ended questions: Students are asked to explain the reasoning behind their answers. **Second, project assignment:** Students apply energy concepts to solve real-world problems. **Third, portfolio**: A collection of students' work that shows the development of their understanding.[23]

The implementation of Deep Learning for teaching the concept of energy in MI faces several challenges. The first challenge is the limitation of teachers' pedagogical content knowledge. Many MI teachers do not yet fully understand the concept of energy in depth, let alone master effective pedagogical strategies to teach this concept to elementary school students. These limitations can lead to learning that only focuses on memorizing definitions and facts, without giving students the opportunity to explore and construct their own understanding.

The solution to this challenge is through a continuous professional development program for teachers. This program should not only focus on strengthening science content but also on specific pedagogy for teaching science at the elementary school level. Teachers need to be equipped with an understanding of common student misconceptions regarding energy, strategies to identify and address these misconceptions, and a repertoire of learning activities that can facilitate Deep Learning. Additionally, teacher communities of practice can be formed to share experiences and best practices in teaching the concept of energy.

The second challenge is the limitation of resources and learning facilities. Learning that encourages Deep Learning often requires teaching aids, experimental materials, or supporting technology that is not always available in all MI, especially in remote areas or madrasahs with limited budgets. These limitations can hinder teachers in designing exploratory and hands-on learning.

The solution to this challenge can be thru the use of local and inexpensive materials to create simple teaching aids. For example, to demonstrate potential and kinetic energy,

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[22] Gandi Wibowo, Deni Gunawan, and Dinny Mardiana, "Implementasi Pendekatan Pembelajaran Mendalam (*Deep Learning*) Dalam Meningkatkan Pemahaman Konsep Siswa Di Sekolah Dasar," *Jurnal Ilmiah Pendidikan Dasar* 10, no 2. September (2025) : 145-158.

[23] Muhammad Arsyad et al., *Konsep Dasar IPA*, ed. Muhammad Iqbal Al Ghozali (Kuningan: CV Aina Media Baswara, 2024)., 38.

teachers can use balls and inclined planes made from boards and wooden blocks. To show the conversion of light energy into heat energy, teachers can use magnifying glasses and paper. The teacher's creativity in utilizing available resources is key. In addition, collaboration with parents and the community can help provide the materials needed for experiments.

The third challenge is the learning habit that is teacher-centered and prioritizes memorization. Many students, parents, and even teachers believe that a child has succeeded in learning if they can memorize many things, rather than how deeply they understand. This habit can hinder deep learning because deep learning methods take longer and are more complex compared to regular learning methods.

To address this issue, the perspectives of all parties involved in education must change: Teachers need to explain to students and parents that deep understanding is far more important than mere memorization. Assessment methods must change to reflect deep learning. In this way, students and parents will see that what is valued is the quality of understanding (how deeply they understand), not the quantity of information (how much is memorized). Teachers need to be patient and consistent in applying this approach, as changing habits takes time.

It should also be noted that the *Deep Learning* approach aligns with the goals of the Merdeka Curriculum, which emphasizes contextual, innovative, and critical learning. In this context, *Deep Learning* does not merely build students' knowledge of energy concepts. Deep learning enhances critical thinking, collaborative, and communicative skills throughout the learning process.

Concept of the Material: Properties of Changes in the State of Matter Using the Deep Learning Approach

A substance is anything that has mass, volume, and occupies space in the universe; it is often referred to as matter or an object. Mass, on the other hand, is a measure that indicates the quantity or amount of a substance's components. The unit of mass is the kilogram, denoted by the symbol kg, while mass or mass in grams is denoted by the symbols kg and g.

Volume and mass are sometimes considered similar, whereas volume is a measure that indicates how much space a substance occupies. The unit of volume is called a liter or milliliter, symbolized as L or mL. It has mass because it can be measured and occupies space in a specific container. For example, water, water is an object that can be seen and felt, water has mass and requires a container, meaning water occupies space, like water in the ocean and mineral water in a bottle.[24]

Every object or substance on Earth and its surroundings is influenced by the Earth's gravitational pull, commonly referred to as Earth's gravity. The quantity that indicates the gravitational force on an object or substance is called weight. The unit of weight is called the kilogram-force, denoted as kgf, or it can be called the gram-force with the symbol gf.

The gravitational force on an object or substance at different locations can be different. This means that the weight of an object or substance can change while the mass of the object or substance remains constant. Every object has a form and can undergo a change in form, and can be used as a basic material in the production of goods.

Changes in form are divided into two ways, namely:

First, physical changes (changes in matter that do not involve the formation of a new substance, for example, water turning into ice). **Second, chemical changes** (changes in substances accompanied by the formation of new substances, for example, wood being burned into charcoal or ash).

Based on the state of matter, substances are divided into three types: solid, liquid, and gas. The changes in the state of substances include: the change from solid to liquid called

[24] V K Sally, *KIMIA (Bahan Ajar Untuk SD)*, (Jakarta: Yudhistira, 2013)., 38-42.

melting, liquid to solid called freezing, liquid to gas called evaporation, gas to liquid called condensation, and solid to gas called sublimation. The processes of these changes in the state of matter will be explained in more detail in the paragraph below:

Melting, melting in other terms is called liquefying or fusing. For example, a craftsman who melts tin, melts glass, or melts iron. The reason why the solid object melts or liquefies is because it is given energy or heat. The more heat energy the object or substance absorbs, the greater the distance between the particles of each substance, causing their movement to become faster. Heating continues until a certain temperature is reached, making the particles move irregularly, which is why a solid form can change into a liquid form.

Freezing, freezing due to a drop in temperature. When the temperature decreases, its energy will decrease because it is released by the liquid, causing the movement of its particles to slow down. If the temperature continues to drop, the particles can lose their energy, becoming slower and the movement between the particles getting closer. At a certain temperature, the particles can lose their energy, eventually their movement only vibrates in place and then they come closer together. As a result, the form of the object or substance that was originally liquid changes to solid, a process called freezing.

Condensation. We also often hear the term condensation. In fact, condensation is a substance or liquid that turns into a gas. Water vapor that cools caused its particles to slow down and move closer together, similar to the particles of a liquid. This transformation of a gas into a liquid is called condensation.

Subliming. An example of sublimation occurs when camphor is placed inside a wardrobe. If observed, the camphor will gradually shrink in size and eventually disappear, while the wardrobe will take on the pleasant scent of camphor. In reality, the camphor does not disappear; rather, it undergoes a transformation from a solid substance into a g. This transformation from a solid substance into a gas is called sublimation.[25]

The application of the Deep Learning approach in learning the properties and changes of matter can be carried out thru the following stages:

Providing Real Context. The teacher begins the lesson by relating the material to the students' daily experiences, such as ice melting or water evaporating when heated.

Exploration and Experimentation. Students are invited to conduct simple experiments, such as observing the transformation of ice into water and steam. Thru this activity, students not only see but also understand the process of matter changing states.

Discussion and Analysis. The teacher facilitates group discussions to discuss the observation results. Students are trained to express opinions, ask questions, and draw conclusions from the experiment results.

Reflection and Concept Reinforcement. At this stage, students reflect on what they have learned and relate it to the correct scientific concepts. The teacher provides reinforcement to deepen the students' understanding. With this approach, learning becomes more memorable and students are able to thoroughly examine the concept of the transformation of matter.[26]

Concept of Earth and Universe Matter with a Deep Learning Approach

Deep learning in the context of education is a learning strategy that focuses on the reinforcement of concepts in a deep, meaningful, and sustainable manner. The characteristic of this learning process is not only oriented toward mastery of memorization, but also toward

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[25] Eka Mega Purnama & Zulfadewina, "Pengaruh Penerapan Kontekstual Terhadap Hasil Belajar IPA : Konsep Perubahan Wujud Benda Kelas IV SDIT Insan Madani Jakart*a,*" *Journal on Education* 07, no.01 (2024): 509-513.

[26] Alya Fitriani and Santiani, "Analisis Literatur: Pendekatan Pembelajaran *Deep Learning* Dalam Pendidikan.", 50-57.

the students' thinking process in understanding, relating, and applying knowledge. Deep learning is closely related to the development of higher-order thinking skills or Higher Order Thinking Skills (HOTS).[27]

In deep learning-based learning activities, students are encouraged to be active in the learning process through observing, asking questions, exploring, discussing, and drawing conclusions. Teachers act as facilitators who guide students in building knowledge independently. This approach is highly relevant for elementary education because it helps students understand concepts holistically from the very beginning. Deep learning also emphasizes the urgency of the evaluation process in teaching and learning activities. Through reflection, students can review what they have learned, understand their mistakes, and reinforce concepts they have not yet fully grasped. This process helps students build knowledge continuously and prevents them from easily forgetting the learning material.[28]

Furthermore, *Deep Learning* requires simultaneous cognitive and emotional engagement from students. Students do not merely know "what" a concept is, but also understand "why" and "how" it works.[29] Thus, learning becomes more meaningful and has a long-term impact on students' understanding. This approach is also in line with the demands of the Merdeka Curriculum, which emphasizes meaningful learning and the strengthening of the Pancasila student profile.

Science education in Madrasah Ibtidaiyah aims to introduce students to natural phenomena scientifically while fostering a strong interest and concern for environmental sustainability. Science in MI is not limited to theoretical concepts but also emphasizes hands-on learning experiences and connections to students' daily lives. Science teaching and learning activities at the elementary level must be designed in accordance with students' cognitive developmental stages, specifically by providing concrete experiences before moving on to abstract understanding. Therefore, teachers need to use various methods, media, and learning strategies so that students can construct concepts gradually and meaningfully.

The Earth and the Universe unit is part of science education that explores various natural phenomena, such as the Earth's shape and layers, the Earth's and Moon's orbits, the solar system, and natural events occurring around humans. This subject matter has a relatively high level of abstraction because most of its subjects of study cannot be directly observed by students. This situation often leads students to struggle with understanding concepts and tend to merely memorize the information presented by the teacher. Therefore, it is crucial to implement learning activities that encourage students to build comprehensive understanding by linking concepts to real-world experiences and using appropriate learning media.[30]

The material on Earth and the universe is also closely related to human life, such as the influence of Earth's rotation on the change of time and seasons. Therefore, the teaching of this material needs to be presented contextually so that students can understand its benefits and impacts in daily life. The Deep Learning approach allows students to connect

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[27] Ridwan Abdullah Sani, *Pembelajaran Berbasis Higher Order Thinking Skills (HOTS)* (Jakarta: Bumi Aksara, 2019), 57-60 https://books.google.co.id/books?id=GrfrDwAAQBAJ&printsec=copyright&hl=id#v=onepage&q&f=false.

[28] Gandi Wibowo, Gunawan, and Mardiana, "Implementasi Pendekatan Pembelajaran Mendalam (*Deep Learning*) Dalam Meningkatkan Pemahaman Konsep Siswa Di Sekolah Dasar.", 145-158.

[29] Erike Wulandari and Richardus Eko Indrajit, *Deep Learning Book: Menemukan Makna Dengan Pembelajaran Mendalam* (Yogyakarta: Penerbit ANDI, 2025)., 44-48.

[30] Fitri Amalia et al., *Panduan Guru Ilmu Pengetahuan Alam Dan Sosial*, (Jakarta Selatan: Pusat Perbukuan Kompleks Kemdikbudristek, 2023)., 61-65

scientific concepts with the realities they experience. Additionally, the material on Earth and the universe has great potential to develop students' critical thinking skills. Through the analysis of natural events, students can be encouraged to understand cause-and-effect relationships and the impact of natural phenomena on human life. With the Deep Learning approach, abstract material can be simplified thru illustrations, simulations, and meaningful discussions.[31]

The application of Deep Learning in teaching and learning Earth and Universe science subjects in primary education can be carried out thru several stages. First, the teacher relates the material to the students' daily experiences, for example, by observing the changes between day and nite or common weather phenomena. Second, the teacher uses learning media, such as pictures, videos, or simple models, to help students visualize abstract concepts. This media serves as a means to reinforce concept understanding and foster students' interest in learning. Third, the teacher encourages students to discuss and ask questions related to the material being studied. Thru discussions, students can exchange opinions and build understanding together. Simple reflection activities, such as retelling the material in one's own words, also become an important part of Deep Learning-based education.[32]

In practice, teachers can also implement simple project-based learning, such as creating a solar system model from recycled materials or observing the changes in the sun's shadow at specific times. These activities motivate students to learn actively, collaborate, and understand concepts in depth. Thus, learning is not only centered on the teacher but also focuses on the students' learning experiences.[33]

Deep Learning-based science education provides various benefits for MI students. Students will be more active in teaching and learning activities, have a deeper understanding of concepts, and be able to relate the material to everyday life. In addition, this approach also helps improve critical thinking skills, curiosity, and scientific attitudes. For teachers, the Deep Learning approach can be an effective alternative learning strategy to improve the quality of science education in MI.[34] Learning is no longer centered on the teacher but focuses on student activities and learning processes. Overall, the implementation of Deep Learning in science teaching and learning activities in MI can enhance the quality of education and student achievement. This approach helps students understand concepts related to the Earth and the universe in a more meaningful way, ensuring that the knowledge gained is not easily forgotten and can be applied in daily life.

Previous research has not comprehensively examined whether the MI science curriculum is suitable for implementation using the Deep Learning approach. Based on the literature cited above, which references earlier articles, it has been proven that the Deep Learning approach is appropriate and safe to apply in all aspects of the science curriculum, whether it requires theoretical or practical understanding.

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[31] Muhammad Arsyad et al., *Konsep Dasar IPA*., 39-44.

[32] Wardimansyah Ridwan, *Inovasi Dalam Strategi Belajar Mengajar Abad 21*, (Sukoharjo: Tahta Media Group, 2024)., 55.

[33] Pahenra A Nongko, *Deep Learning: Strategi Dan Implementasi Di Kelas*, (Padang: Gemilang Press Indonesia, 2024)., 51.

[34] Alya Fitriani and Santiani, "Analisis Literatur: Pendekatan Pembelajaran *Deep Learning* Dalam Pendidikan.", hlm 50-57.

CONCLUSION

Based on the discussion that has been described, it can be concluded that: The deep learning approach provides a solution by emphasizing active student participation, deep conceptual understanding, and the connection between learning and real-life situations. Through this approach, students not only understand the concept of living entities and the environment but also understand the importance of maintaining ecological balance as well as being responsible for their natural environment. By the implementation of the deep learning approach, science education in MI is expected to encourage students' environmental awareness sustainably. Science learning is more than just a process of transmitting knowledge but an approach for developing ecological consciousness since an early age. A suitable learning approach has great potential to help Madrasah Ibtidaiyyah students develop greater comprehension of the concept of energy and how it evolves. This approach integrates active engagement, reflection, and meaningful learning experiences by the implementation of participatory learning media. Through this approach, students do not only memorize concepts but also are able to apply them in various contexts of daily life. The application of the Deep Learning approach to the subject matter of the properties and changes in the physical state of objects at MI proved to encourage student participation during teaching and learning activities, enhance conceptual understanding, and foster natural curiosity and a scientific attitude. Through contextual activities, simple experiments, discussions, and reflection, students not only learn the term change of state of matter but also understand the process and its application in daily life. Thus, the Deep Learning approach is highly relevant for implementation in science education at Madrasah Ibtidaiyyah as an effort to create active, effective, and meaningful learning, and to continuously improve the quality of student learning outcomes. The quality of learning will improve because learning is not simply about memorizing the content but also about understanding concepts more thoroughly and meaningfully. This is important because Earth and the universe-related material has a relatively high level of conceptualization for MI students. Through activities such as observing, discussing, reflecting, and using appropriate learning media, students can build conceptual understanding gradually and sustainably. Therefore, MI teachers are expected to be able to develop creative and innovative science learning strategies using the Deep Learning approach.

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