

Analysis of Misconceptions in the 2023 Revised Edition of 4th Grade Elementary School Science Textbook

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Abstract. Identifying misconceptions in the 2023 revised edition of the natural and social sciences (IPAS) of 4th grade book published by the Indonesian Ministry of Education and Culture is the aim of this research. Qualitative descriptives were implemented in this research with a content analysis strategy. The 2023 revised edition of the 4th grade natural dan social sciences book published by the Indonesian Ministry of Education and Culture is used as a source of study data. The level of misconception category consists of misidentification, overgeneralization, oversimplification, obsolete concept and term and under generalizations. Based on the research carried out, the results showed that there were misconceptions about the material in the 2023 revised edition of the 4th grade natural dan social sciences book. In the overgeneralization category there are 4 concepts, namely photosynthesis, changes in forms of energy, muscle force and the greenhouse effect. In the oversimplifications category, there are 4 concepts, namely photosynthesis, muscle force, magnetic force and gravitational force.

Keywords: misconception, science concept, teaching materials, textbook, IPAS

Introduction

Natural Science is defined as knowledge about the universe, the phenomena that occur in it, and everything in it. According to (Tami et al., 2023), natural science (IPA) comes from the term natural science, where natural means natural and related to nature, while science means knowledge. In Indonesian, the word science has been absorbed into science and technology, which are the equivalent of natural sciences and are used in the field of natural sciences (Budianti et al., 2024). Science or a is knowledge that consists of various concepts, principles, laws and theories obtained through a creative and systematic process. This process includes discovery, continuous observation, calculation strategies, and continuous testing of truth, which is based on curiosity, courage, and perseverance in understanding the secrets of the universe (Suhelayanti et al, 2023). Natural sciences at elementary school level is taught through the process of research and observing natural phenomena, so that students can understand scientific concepts in depth, not just memorize them (Sulikah et al., 2020).

Improving the quality of education is an important role in implementing science learning (Junitasari & Heryanto, 2024). The emergence of quality students, namely individuals who are able to think critically, creatively, logically, and have initiative in responding to issues in society due to developments in science and technology, is one indicator of improving the quality of education through science learning (Suryantari et al.,

2019). Science learning aims to develop students' natural curiosity, improve their ability to ask questions, help them find answers based on evidence to various problems, and equip them with ways of thinking scientifically (Jati, 2020).

According to the Indonesian Dictionary (KBBI), a concept is defined as a framework, idea or interpretation arranged abstractly from a concrete event. Concepts are the basic building blocks of knowledge (Anggraini et al., 2023). The concept of grouping objects or events into an idea whether abstract or not (Ikram et al., 2018). The concept of science is defined as a scientific, systematic and universal understanding or basic knowledge that is taught to students to understand the natural world and phenomena around them. These concepts cover various fields, such as physics, biology, chemistry, geography, and astronomy, which are interconnected and form the basis of scientific knowledge. These concepts provide a framework for thinking that students use to explain, predict, and understand natural events. Arif et al. (2024) found that conception is the process of someone interpreting a new concept by connecting it to previously studied concepts.

Strong conceptual understanding is essential for students to succeed in various disciplines (Liu & Fang, 2023). Preconceptions are the understanding that students have before the learning process begins or that have been obtained through previous formal learning (Arif, et al., 2024). The initial understanding that students have has a significant impact on the process of acquiring knowledge in the classroom (Wirastuti., F., 2023). For educators it is very important to identify and correct students' preconceptions. This process is called conceptual reorientation, where wrong concepts need to be changed or corrected through structured learning so that students do not get trapped in misconceptions. To prevent and overcome persistent misconceptions, teachers need to have the ability to identify and explore students' initial concepts, especially erroneous concepts (Saputri et al., 2023).

Misconceptions are defined as conceptual errors that arise due to erroneous interpretations of information or experiences (Fabilla et al., 2023). Misconceptions in education refer to the difference between the understanding of concepts believed and applied by experts and the concepts understood by students (Arif et al., 2024). Structural misclassification of information obtained by students can cause misconceptions (McAfee & Hoffman, 2021). According to (Shofiyah, 2021) misconceptions can hinder the learning process, both those obtained from daily experiences and during learning activities. Misconceptions can be caused by various factors, including students, teachers, textbooks, learning contexts, and teaching methods used in learning a science (Rohmah et al., 2023) & (Andini & Kurniawati, 2024).

Students' misconceptions can arise from various complex factors, such as incorrect analogies, ambiguous use of terms, or errors in reasoning (López & Marco, 2022). Misconceptions most often occur in abstract science material whose understanding requires visualization in the explanation (Hera & Oktavia, 2023). Teachers as learning facilitators can also be a source of misconceptions. Misconceptions that persist in the long term can be caused by teachers who do not have adequate competence and do not come from an educational background appropriate to the science field (Dewi et al., 2021). Misconceptions in textbooks can be caused by the use of terms that are difficult to understand and inaccurate explanations. In the learning context, the use of language that is not appropriate to students' daily lives can also be a factor in the emergence of misconceptions. Daily life experiences can be the basis for students to construct concepts based on the reasons they have, and this needs to be accompanied by relevant explanations by experts (Fakhriyah & Masfuah, 2021).

Learning methods that do not adapt to learning needs and learning topics are a source of misconceptions in the implementation of learning in the classroom. Teaching that is too monotonous or does not adapt to the characteristics of different concepts will make students experience difficulties in understanding and applying these concepts correctly

(Wardani et al., 2021). A teacher must have sufficient knowledge and understanding to be able to help students correct their conceptual errors (Danil et al., 2023).

In the teaching and learning process, teachers use various types of teaching materials, both printed and non-printed. Textbooks are one of the most frequently used printed teaching materials. Textbooks are designed in a structured manner and carefully selected according to certain objectives that focus on certain subjects or fields of study (Arif et al., 2024). (Tenzer et al., 2022) states that textbooks are a source of information for students in the ongoing learning process as well as a handbook. Selectively choosing books in the teaching and learning process (PBM) is the teacher's duty and responsibility as a learning facilitator. To avoid mistakes in choosing books, teachers need to have good mastery of the material as an important factor (Mubarok, 2023). Selecting appropriate textbooks can improve students' understanding of science. Apart from that, this can also increase students' learning motivation, especially in topics related to science (Risma et al., 2019).

Textbooks used as teaching materials in learning can risk causing misunderstandings in understanding the scientific concepts studied by students. The negative impacts caused by misconceptions about books will be received by students and teachers (Hartanti et al., 2024). Misconceptions in classroom learning are mainly caused by teachers' limited insight and inappropriate selection of textbooks (Andini & Kurniawati, 2024) & (Nurfiyanti et al., 2020). Vocabulary that is too complex and difficult can cause students to misunderstand the contents of a book (Suryandari, 2018). As a result, they can get a wrong understanding of the material presented (Purwaningrum, 2021). Therefore, educators must understand the content of teaching materials well in order to convey concepts correctly and prevent misconceptions. Misconceptions can occur due to inconsistencies between the explanations understood and the concepts put forward by experts (Fakhriyah & Masfiah, 2021).

Several researchers have previously conducted research related to misconceptions in the science concept. Lack of understanding of concepts can trigger misconceptions, which can originate from teaching materials (Saputri et al., 2023) as well as teaching methods (Nasution et al., 2021) & (Danil et al., 2023) at the basic education level. One source of misconceptions in learning is textbooks as teaching materials (Agustina & Indana, 2022). According to (Dewi & Ibrahim, 2019) a clear understanding of theory is needed first before identifying students' errors and misconceptions. Research regarding identifying misconceptions of the fifth grade elementary school students about the properties of light was carried out by (Nurfiyanti et al., 2020). Furthermore, (Pamungkas, 2021) examined the misconceptions of the fifth grade elementary school students regarding the concepts of force and motion. (Hayati et al., 2022) Analyzing misconceptions about science concepts in the fourth grade elementary school students (Mariyadi & WA, 2023) identified misconceptions about science learning regarding gravity in the sixth grade elementary school. (Fabilla et al., 2023) analyzed the misconceptions of the fourth grade students regarding force and motion material using the three-tier test method. Research related to knowledge of the five human senses with a focus on analyzing misconceptions of fourth grade elementary school students using the certainty of response index (CRI) instrument has been carried out by (Marfilinda et al., 2022). Another study using the certainty of response index (CRI) focused on identifying misconceptions of the fifth grade students at SD Negeri 1 Pijiharjo regarding the human digestive system (Indrajatun & Desstya, 2022). (Sinta et al., 2023) carried out research using the certainty of response index (CRI) instrument in science subjects on the human digestive system at SD Negeri 5 Godean, Sleman, with a focus on analyzing misconceptions. Research on the analysis of misconceptions about the fourth grade natural and social science book in the independent elementary school curriculum was carried out by (Budiwati et al., 2023).

Based on previous studies regarding misconceptions in science, researchers conducted research with an analysis design of teaching materials in the form of books for

class IV science students, revised edition 2023, merdeka curriculum published by the Indonesian Ministry of Education and Culture (Fitri et al., 2023). Knowing science concepts that still have misconceptions or misunderstandings is the aim of this research, especially from the students' perspective in the 2023 revised edition of the 2023 revised science book for class IV published by the Indonesian Ministry of Education and Culture. It is hoped that this research will become a basic reference for the government in making policies regarding the preparation and publication of textbook teaching materials for students.

Methods

The research is qualitative with a content analysis strategy. Observation sheets about the contents of the book became data collection instruments. This research focuses on the science material contained in the 2023 revised edition of the class IV science book published by the Indonesian Ministry of Education and Culture. This research examines the level of misconceptions which include misidentification, overgeneralization, oversimplifications, obsolete concepts and terms, and under generalizations.

The level of misidentification occurs when the explanation in a book does not match other references, resulting in errors in identifying and explaining a process. The overgeneralization category appears if only some aspects or problems of science are presented in the concept. Oversimplifications occur when the explanation of a concept in a textbook is less detailed than in a reference book, such as a graph without explanation or a definition that is too broad without mentioning exceptions. Concepts or terms that are no longer in accordance with the latest scientific developments are included in the category of obsolete concepts and terms. Meanwhile, under generalizations describe the use of old terms or phrases in textbooks to explain concepts that already have new terms in reference books.

Results and Discussion

The results of the analysis of misconceptions in the 2023 revised edition of the class iv science book published by the Indonesian Ministry of Education and Culture are presented as Tabel 1.

Table 1. Results of analysis of the 2023 revised edition of 4th grade science book

No	Category	Amount
1.	Misidentifications	0
2.	Overgeneralizations	7
3.	Oversimplifications	8
4.	Obsolete Concept and Terms	0
5.	Under Generalizations	0
		15

Overgeneralizations describe some of the science problems of existing concepts. In the context of misconceptions about natural science (IPA) concepts, overgeneralization refers to errors in understanding where students draw conclusions that are too broad or inappropriate based on limited information. According to (Arif et al., 2024) the condition of an incomplete or incorrect explanation because the analogy used to explain the concept is incorrect is an illustration of overgeneralization. In line with this research, Kuncoro dan Oktaviani (2020) stated that students often experience misconceptions due to errors in generalizing the concepts they have learned to different contexts.

Oversimplifications if a concept is too simplified (Agustina et al., 2016), the concept presented in the textbook is incomplete and different from the concept literature (Elnissa & Jayanti, 2023). Oversimplification refers to errors of understanding in which students draw conclusions that are too narrow or inappropriate based on limited information. On page 10, overgeneralizations are found, namely in infographics and the statement that plants use light energy from the sun to produce their own food in order to survive.

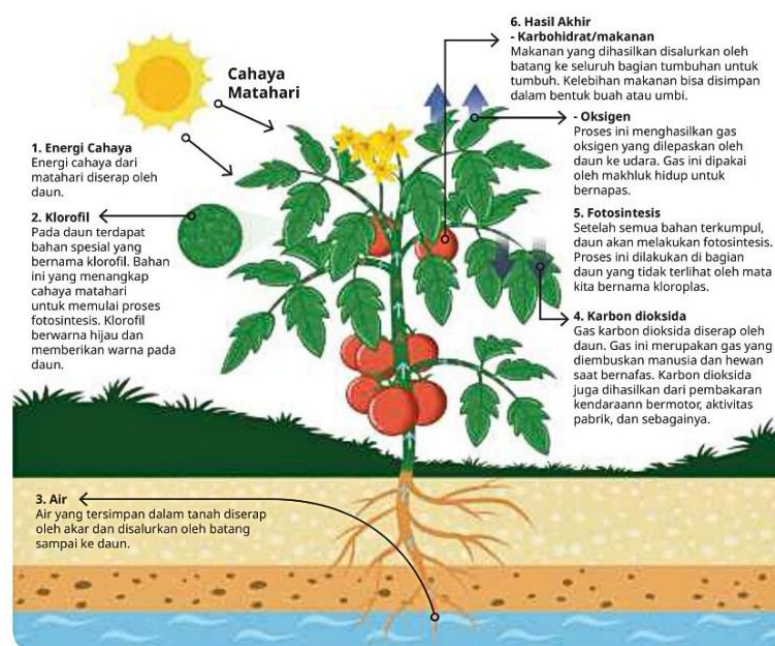


Figure 1. Photosynthesis infographics is on page 10 in the student book

The statement above causes misconceptions because photosynthesis is thought to take place only with the help of sunlight and directly during the day. Students may interpret that only the sun can provide sufficient light for the photosynthesis process, so they do not realize that artificial light can also be used in this process. Photosynthesis does not only depend on sunlight, but can also utilize various types of light energy (Muna, 2012). Research shows that variations in the LED light spectrum have a significant effect on plant growth, indicating that photosynthesis can occur with artificial light sources (Putri & Sudarti, 2024).

There are several types of plants that can adapt to low light conditions or even no direct sunlight, such as plants that live under forest canopies or in deep aquatic environments (Febrianti et al., 2023) Suggesting that some plant species have special adaptations that allow them to carry out photosynthesis in low light conditions or use alternative energy sources. For example, some epiphytic plants in tropical rainforests can photosynthesize with high efficiency even though they receive little sunlight. On page 10, a misconception was found in the oversimplifications category in the statement that plants use light energy from the sun to produce their own food in order to survive. Photosynthesis is the process by which plants make their own food (Budiwati et al., 2023). Students will interpret that the photosynthesis process is only a process for making food, without realizing that this process also plays a role in the production of oxygen and substances needed for growth and development in the form of chemical energy (Susilo et al., 2024).

Oversimplification is found on page 10 in the explanatory statement in the photosynthesis infographic point 2, namely "In leaves there is a special substance called chlorophyll. This material captures sunlight to start the photosynthesis process. Chlorophyll

is green and gives color to leaves.” This statement causes a misconception of understanding which allows students to interpret that only leaves contain chlorophyll. Chlorophyll is a pigment that functions in absorbing light (Muna, 2012). In fact, chlorophyll is not only found in leaves, but also in the stems and roots of plants. In plants such as cacti, chlorophyll can be found in various parts and is distributed throughout the body, including the stem (Dwilestari & Desstya, 2022). Overgeneralizations are also found in the same statement and allow students to interpret that only plants with green leaf substances (chlorophyll) are capable of photosynthesis. Plants with non-green pigments can also carry out photosynthesis, such as red betel which has a leaf pigment called redhopil (Dwilestari & Desstya, 2022).

On page 13, an overgeneralization is found, namely that photosynthesis can occur due to sunlight. In the infographic image, sunlight energy is transmitted to plants.

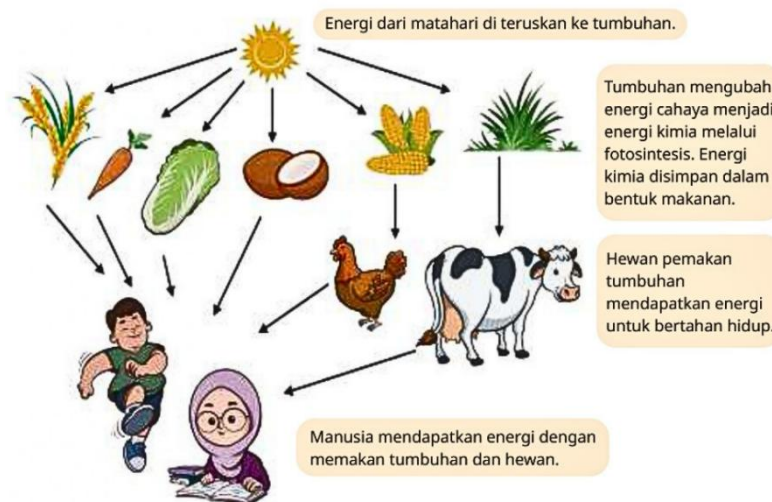


Figure 2. Infographics of the sun as an energy source is on page 13 in the student book

The statement above causes misconceptions because photosynthesis is thought to take place only with the help of sunlight. Students will interpret that only sunlight can help the photosynthesis process and cannot be helped by other sources. The photosynthesis process can also take place with the help of fluorescent light energy which replaces solar energy and artificial light with the appropriate spectrum. There are oversimplifications in the explanatory statement in the infographic Figure 2 that "plants convert light energy into chemical energy through photosynthesis. Chemical energy is stored in the form of food." Students will interpret that all the results of photosynthesis in the form of chemical energy will be stored in the form of food without realizing that plants utilize this energy for their own metabolic needs. Studies show that not all photosynthesis products are stored; most of it is used immediately for cellular energy needs.

The general statement that electricity results from the conversion of motion energy into electrical energy is a misconception found on page 15 in the overgeneralizations category.

Contohnya adalah listrik. Dari mana listrik berasal? Umumnya listrik dihasilkan dari perubahan energi gerak menjadi energi listrik. Manusia memanfaatkan sesuatu yang bisa menghasilkan gerak untuk memutar generator listrik. Perhatikan gambar pembangkit listrik tenaga air dan tenaga uap berikut.

Figure 3. Change of motion energy into electrical energy is on page 15 in the student book

This statement is a misconception because it ignores the various energy sources and processes carried out to produce electricity. For example, in a solar power plant, light energy is directly converted into electrical energy without going through the motion energy stage. Students may interpret that all power plants operate by converting mechanical energy into electrical energy, thereby ignoring other processes such as fuel combustion or nuclear reactions. Electricity can be generated from various energy sources, such as chemical energy in batteries, nuclear energy in nuclear reactors, and water potential energy in hydroelectric power plants. Each of these sources has a different energy conversion mechanism, and not all of them involve converting mechanical energy into electrical energy. Solar power and renewable energy are new sources for producing electrical energy (Solikah & Bramastia, 2024; Kharisma et al., 2024).

On page 29 the statement that when Ian and Banu lift, push and pull objects, they use muscle force is found to be an oversimplification. The interpretation that emerges is that muscle force can be observed directly and only humans have the muscle strength to move objects.



Figure 4. Muscle force for pushing and pulling objects is on page 15 in the student book

Students may interpret that muscle force is only possessed by humans and is only related to visible body movement activities such as moving or moving objects. Apart from humans, animals also have muscles as an active means of movement in their bodies (Budiwati et al., 2023). Muscle force is not only related to visible movement but also to microscopic activity such as shifting of actin and myosin filaments at the cellular level. Muscle contractions then tighten and produce movement to be carried out which is the source of muscle force (Arruum & Desstya, 2024).

Saat Ian dan Banu mendorong dan menarik benda, mereka menggunakan gaya otot. **Gaya otot adalah gaya yang dikeluarkan dari manusia atau hewan menggunakan otot pada tubuh mereka.**

Saat kontainer diberikan gaya dorong atau tarik, maka akan terjadi gesekan antara kontainer dan permukaan lantai. Hal ini menyebabkan terjadinya gaya gesek. **Gaya gesek adalah gaya yang terjadi saat dua benda saling bergesekan.**

Wah, ternyata walaupun sudah berhasil mendorong kontainernya, Ian dan Banu nampak kelelahan. Apakah kalian menemukan cara yang lebih baik dari mereka?



Mendorong peti ini melelahkan, tetapi berhasil juga ya sampai luar.

Iya, tapi lebih mudah dibanding diangkat.

Figure 5. Muscle force for pushing and pulling objects is on page 29 in the student book

The statement that muscle force is the force exerted by humans or animals using the muscles in their bodies is a misconception found on page 29 in the overgeneralizations category. This statement generalizes that all force generated by living creatures comes from muscles, some animals use other mechanisms, such as hydraulic pressure in starfish. Students may interpret that all animal movement comes from muscle contraction, without considering the existence of additional mechanisms such as the exoskeleton or fluids in the body. Research related to animal anatomy shows that movement mechanisms vary greatly and do not always depend on muscles (Anggraini et al., 2023).

Oversimplifications found in another illustration on page 30 are a group of children carrying out a tug of war activity by pulling the rope in opposite directions. Students may interpret that muscle force only appears in humans and is seen in direct activities such as when pulling, pushing or moving something. The illustrations and explanations in the book are incomplete so that the understanding of muscle force is not comprehensive and creates differences in students' understanding of the concept of muscle force.

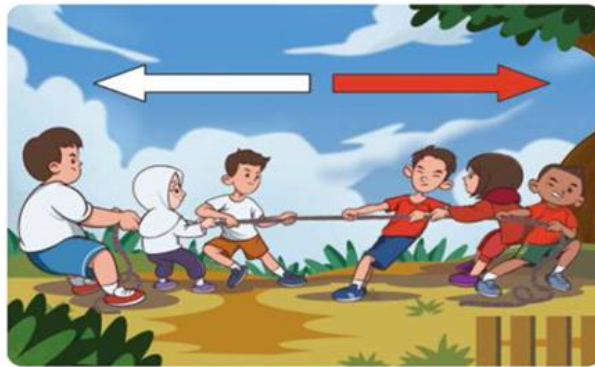


Figure 6. Muscle force for pushing and pulling objects is on page 30 in the student book

The statement that a magnet is an object that can attract objects made of iron is an oversimplification found on page 34. This statement simplifies the concept by assuming that only objects made of iron can be attracted by a magnet, while objects made of other materials cannot be attracted.

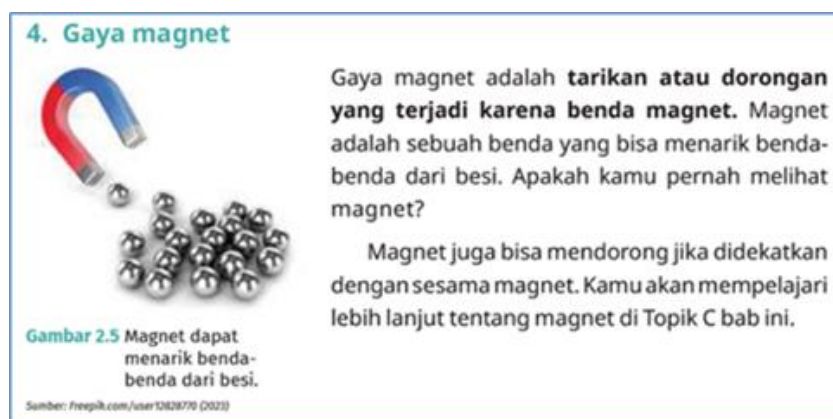


Figure 7. Magnetic attraction force is on page 34 in the student book

Students may interpret that magnets can only attract objects and are made from iron. A metal that can attract objects with metallic elements is a magnet (Majma et al., 2024). Magnetism is often interpreted as symptoms and properties that can affect certain

materials in the surroundings (Salbiah et al, 2022). The materials for making magnets are not limited to just iron, but include other types of metals such as nickel and cobalt. According to (Musni et al., 2021) materials that have strong magnetic power besides iron are nickel and cobalt.

On page 41, oversimplifications are found in the illustration which explains iron scraps attached to a magnetic excavator. This statement simplifies that only iron objects can be attracted by a magnet.



Figure 8. Magnetic attraction force is on page 41 in the student book

Magnets can only attract those made of iron, which is the student's interpretation that emerged. Magnets can attract metal objects, but are not limited to iron, but also include other metals such as nickel and cobalt. Objects with magnetic properties are a group that can only be attracted by magnetic forces (Arruum et al., 2024). Magnetic objects are generally metals such as iron, nickel and cobalt. In accordance with the statement that a magnet is a part of metal that has the ability to attract metal objects (Shofiyah, 2021).

The ability to attract objects with metallic elements and having two positive and negative poles is a characteristic of magnetism in general and has an area around the magnet that has magnetic properties when the field affects other objects (Anggraeni & Nugroho, 2023). Students' real experiences in life can be a source of misconceptions about magnetism. Students believe that only iron can be a magnet because other types of metal are rarely found in everyday life (Musni et al., 2021). Students are still unfamiliar with metals other than iron so their beliefs are not in accordance with the correct concept of magnetism. Students' ability to understand the material influences students' misconceptions (Suparno, 2013).

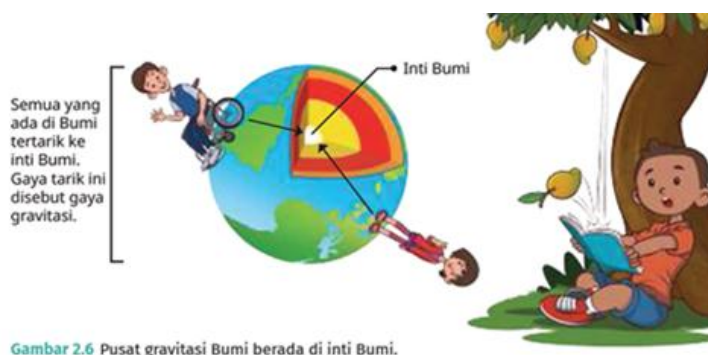


Figure 9. Earth's gravitational force is on page 34 in the student book

Students will interpret that all objects that have mass on the earth will be directly attracted to the earth's core directly. Students tend to think that gravity only has one absolute direction (to the earth's core), without understanding the non-uniform distribution of the earth's mass. The gravitational force acts toward the Earth's center of mass, which is approximately near the Earth's geometric center. Not all objects are "directly attracted" to the Earth's core because the distribution of gravity depends on the mass of the Earth and its position relative to the object.

The gravitational force acts on objects that have working points that are not directly connected to the object so it is included in the type of non-touch force (Muhtar & Mahyudin, 2020). According to (Kurniawati et al, 2022) the force that pulls objects towards the earth's core is defined as the earth's gravitational force. This statement is in line with the statement that every object can fall to the earth because of the attractive force called gravity, which pulls these objects towards the earth (Lestari et al, 2024).

On page 84, overgeneralizations are found in illustrative images that explain the process of the greenhouse effect. This illustrative image generalizes that the cause of the greenhouse effect is due to all human activities.

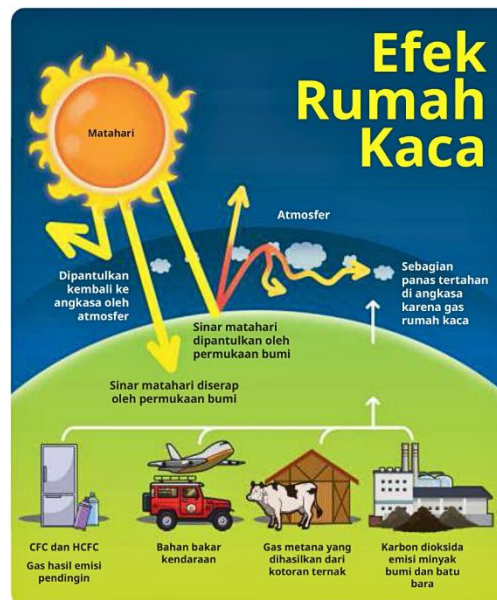


Figure 10. Illustration of the greenhouse effect process is on page 84 in the student book

The explanation in the infographic is not complete so students may interpret that the greenhouse effect on earth is only caused by human activity. This phenomenon maintains the earth's temperature and is essential for life, which is a natural process. Gases in the atmosphere capture and retain heat on the earth, giving rise to a greenhouse effect (Lestari et al., 2023). The greenhouse effect is also caused by natural water vapor and CO₂ gas. According to (Putra & Keluanan, 2022) excessive greenhouse effects can cause disruption and climate change which has the potential to cause disaster, but on the other hand, it also plays a role in maintaining the continuity of life on earth. The accumulation of carbon dioxide and similar gases which causes an increase in greenhouse gases and global warming is the impact of excessive human activity (Leu, 2021).

The curriculum in learning in Indonesia has currently experienced developments and several changes. The merdeka curriculum is the newest curriculum that is being

implemented at all levels of primary and secondary education. The independent learning curriculum focuses on intracurricular and co-curricular material to create a meaningful and intellectual learning process for students (Husna & Rigianti, 2023). Success in implementing the curriculum, especially in implementing learning, depends on several factors, namely the teacher/learning facilitator, teaching materials and learning support media.

Teaching materials include all types of materials that support teachers in the learning process, one of which is textbooks. Textbooks play a role in presenting various knowledge and information (Sekarinasih, 2018). Textbooks as teaching materials are used as a source of material and evaluation of students' learning progress. The learning material for the revised edition of the natural and social science book for 4th grade students includes science and social studies content. There are eight chapters, with details of four chapters of science subject content and four chapters of social studies subject content. Material includes; chapter 1 changing energy forms, chapter 2 forces around us, chapter 3 this is where I live, chapter 4 climate and its changes, chapter 5 this is typical of my area, chapter 6 my role in the school and community environment, chapter 7 cultural diversity and local wisdom and chapter 8 becoming an environmental hero.

In chapter 1 there are misconceptions on textbook pages 10 and 15 on the topic of energy changes and photosynthesis. There are illustrative images and explanations in the illustrations that cause misconceptions. Misconceptions that arise in the categories of overgeneralizations and oversimplifications. In the category of overgeneralizations, the misconceptions that arise include photosynthesis being thought to be able to take place only with the help of sunlight and directly during the day. Research shows that photosynthesis can occur with artificial light sources (Putri & Sudarti, 2024). Some plant species have special adaptations that allow them to carry out photosynthesis in low light conditions or use alternative energy sources (Febrianti et al., 2023). Photosynthesis can only occur in plants that contain chlorophyll is a misconception that may arise. In reality, this process can also take place in plants with non-green pigments, such as red betel which has a leaf pigment called redhopil (Dwilestari & Desstya, 2022). Another misconception is that electrical energy is only produced by motion energy. Electricity can be generated from various energy sources, such as chemical energy in batteries, nuclear energy in nuclear reactors, and water potential energy in hydroelectric power plants. Each of these sources has a different energy conversion mechanism, and not all of them involve converting mechanical energy into electrical energy.

In the oversimplifications category, misconceptions that arise include that the photosynthesis process is only considered a process for making food. The process of making food for plants themselves and producing oxygen and chemical energy to grow and develop is photosynthesis (Susilo et al., 2024). The next misconception is that only leaves are thought to contain chlorophyll. In plants such as cacti, chlorophyll is not only found in the leaves, but is also spread throughout the body, including the stems and roots (Dwilestari & Desstya, 2022). Apart from that, another misconception arises, namely that the process of processing food substances is carried out by plants without the help of other supports, in reality the photosynthesis process requires the help of sunlight and appropriate artificial light as well as the support of other environmental factors. Photosynthesis consists of two main stages, namely the light reaction which takes place in the thylakoids and the Calvin cycle which occurs in the stroma. This process requires sunlight to take place (Yustiningsih, 2019).

In chapter 2 there are misconceptions on textbook pages 29, 30, 34 and 41 on the topic of force which consists of muscle force, magnetic force and gravitational force. There are illustrations and explanations in the illustrations which cause misconceptions in the categories of overgeneralizations and oversimplifications. In the category of overgeneralizations, the misconception that arises on the topic of muscle force is that all

force produced by living creatures comes from muscles and all animal movement comes from muscle contractions, without considering the existence of additional mechanisms such as exoskeletons or fluids in the body. Research related to animal anatomy shows that movement mechanisms vary greatly and do not always depend on muscles (Anggraini et al., 2023).

In the oversimplifications category, misconceptions that arise on the topic of muscle force include that muscle force is only possessed by humans and is only related to physical activity. Animals as living creatures that have muscles as active means of movement also exert muscle force (Budiwati et al., 2023). Muscle contractions then tighten and produce movement which is the source of muscle force (Arruum & Desstya, 2024). Misconceptions on the topic of magnetic force include that only objects made of iron can be made into magnets and attracted by magnets. Magnets are also able to attract objects made of metal such as nickel and cobalt. Apart from iron, materials that have strong magnetic power are nickel and cobalt (Musni et al., 2021). Objects with metallic elements can be attracted by magnets which are metallic objects (Majma et al., 2024). The materials for making magnets are not limited to just iron, but include other types of metals such as nickel and cobalt. Misconceptions on the topic of gravitational force include that all objects that have mass on the earth will be directly attracted to the earth's core. Not all objects are "directly attracted" to the Earth's core because the distribution of gravity depends on the mass of the Earth and its position relative to the object. Gravitational force is included in the non-touch force (Muhtar & Mahyudin, 2020). (Kurniawati et al, 2022) stated that towards the earth's core objects on the earth are pulled by the force of gravity.

In chapter 4 there are misconceptions on page 84 of the textbook on the topic of the greenhouse effect. There are illustrative images and explanations in the illustrations which cause misconceptions in the category of overgeneralizations. The misconception that arises is that only human activities on earth cause the greenhouse effect without considering that this is a natural process to maintain the earth's temperature, water vapor and CO₂ gas which naturally exist also contribute to the process. Too much greenhouse effect can have disastrous consequences for changing and disrupting the climate, but it also helps maintain life on earth (Putra & Keluanan, 2022).

Conclusion

From the research conducted, 2 (two) categories of misconceptions were found, namely the overgeneralization category, there were 7 findings in 5 concepts, namely about photosynthesis, energy changes, muscle force, magnetic force and the greenhouse effect, in the oversimplifications category there were 8 findings in 4 concepts, namely photosynthesis, energy changes, muscle force and gravitational force. Due to the misconceptions that are still found, corrective steps are needed in the form of policies related to the preparation and publication of teaching materials. The government needs to set strict standards in preparing science textbooks to ensure that there are no misconceptions through the following steps: 1) Requires review and verification by academics, educational practitioners and scientists before publication, 2) Form an independent evaluation team to identify conceptual errors and ensure the book is updated regularly according to developments in science, 3) Involving teachers in the book preparation process by providing input based on teaching experience, as well as receiving training to recognize and handle misconceptions in learning, 4) Textbooks need to be presented contextually with language that is easy to understand, accurate illustrations, and interactive material to increase students' understanding, and 5) Implementation of a feedback mechanism from schools and teachers to review the effectiveness of books and enable the reporting of errors that can be corrected immediately so that the quality of textbooks remains maintained and relevant to the world of education.

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