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Identification of Students' Misconceptions on Animal Life Cycle Using a Three-Tier Diagnostic Test at Fourth-Grade Students at SDN Sentul 3

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Abstract

Detecting misconceptions due to concise Merdeka Curriculum textbooks is vital as they risk hindering elementary students' science conceptual mastery. This study aims to identify the misconceptions of fourth-grade students at SDN Sentul 3 about the life cycle of animals using a Three-Tier Test based on Certainty of Response Index (CRI). This research method is a descriptive qualitative study using purposive sampling, with 23 students as the sample. The multiple-choice test with CRI consisted of 13 questions covering the sub-concepts of perfect metamorphosis, imperfect metamorphosis, animals that do not metamorphose, life cycle stages, and differences in animal metamorphosis. The results showed that 65.9% of students had misconceptions, 21.7% understood the concept, and 11.7% did not. The highest misconception was found in the sub-concept of imperfect metamorphosis, with a 72.5% rate. The main causes of misconceptions are limitations in direct observation, limited understanding of concepts, and inadequate textbooks that fail to explain the material. This study suggests that teachers use more interactive and innovative learning media so that students can better understand the concepts correctly and can overcome misconceptions in science materials. This study provides a basis for developing more engaging and interactive educational materials. It offers guidance for improving the curriculum to place greater emphasis on conceptual understanding and the use of diagnostic assessments.

Keywords: Animal Life Cycle, Misconceptions, Science Learning, Three-Tier Test

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Abstrak

Deteksi miskonsepsi siswa akibat ringkasnya materi buku Kurikulum Merdeka penting karena yang berisiko menghambat penguasaan konsep sains siswa SD. Penelitian ini bertujuan untuk mengidentifikasi miskonsepsi siswa kelas IV SDN Sentul 3 tentang siklus hidup hewan menggunakan Three-Tier Test berbasis Certainty of Response Index (CRI). Metode penelitian ini adalah kualitatif deskriptif menggunakan purposive sampling, dengan 23 siswa sebagai sampel. Tes berbentuk pilihan ganda dengan CRI terdiri dari 13 soal yang meliputi sub konsep metamorfosis sempurna, metamorfosis tidak sempurna, hewan tidak bermetamorfosis, tahapan siklus hidup, dan perbedaan metamorfosis hewan. Hasil menunjukkan bahwa tingkat miskonsepsi siswa mencapai 65,9%, sementara yang memahami konsep sebesar 21,7%, dan yang tidak memahami konsep 11,7%. Miskonsepsi tertinggi ditemukan pada sub konsep metamorfosis tidak sempurna dengan persentase 72,5%. Penyebab utama miskonsepsi adalah keterbatasan dalam pengamatan langsung, pemahaman yang rendah terhadap konsep, serta penggunaan buku teks yang tidak memadai dalam menjelaskan materi. Penelitian ini menyarankan guru untuk menggunakan media pembelajaran yang lebih interaktif dan inovatif agar siswa lebih memahami konsep dengan benar dan dapat mengatasi miskonsepsi pada materi IPA. Penelitian ini berkontribusi sebagai dasar dalam pembuatan media pembelajaran yang lebih menarik dan interaktif, serta digunakan sebagai pedoman untuk memperbaiki kurikulum agar lebih fokus pada pemahaman konsep dan penggunaan asesmen diagnostik.

Kata Kunci: Siklus Hidup Hewan, Miskonsepsi, Pembelajaran IPAS, Three-Tier Test

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INTRODUCTION

Science is an essential subject that should be taught from elementary school. This is because most daily human activities are related to science, ranging from simple tasks to those requiring complex thought. This aligns with Sampe et al. (2022), who stated that elementary-aged children encounter science from the simplest to the most complex levels in their daily lives. Science education for elementary students aims to develop their ability to understand and investigate the natural environment, enabling them to master science concepts and benefit from them in everyday life while serving as a foundation for higher education. Generally, elementary students are still in the concrete operational stage, where they learn basic concepts through direct experience (Agustyaningrum et al., 2022). Therefore, learning for elementary students still connects to simple matters.

During elementary education, students learn relatively simple material. Teachers must deliver this material carefully to avoid errors, as mistakes in explaining a subject will make it difficult for students to understand the material or apply it in daily life. If conceptual errors occur even in simple material, they will likely persist in subsequent topics. Such conceptual errors can be minimized through proper planning in the science learning process, ensuring students receive the correct concepts from the teacher and avoid misunderstandings (Riti et al., 2022). Consequently, a strong conceptual understanding from the beginning will support students' success in higher-level learning.

Students' understanding of a concept is referred to as conception, whereas errors in understanding concepts that do not align with scientific consensus are known as misconceptions (Dewi & Ibrahim, 2019). Every student brings their own experiences and knowledge of nature to formal schooling. Therefore, forming a conception, especially in Science and Social Studies (IPAS), requires students' understanding to align with general scientific conceptions. However, students' understanding often deviates, leading to misconceptions.

A misconception is a misunderstanding in grasping a concept. Misconceptions are ideas that do not correspond to scientific definitions in the studied field. Misconceptions can take the form of initial conceptual errors, mislinking between concepts, and having perceptions that do not match the problem (as cited in Nisa et al., 2022). Student misconceptions are difficult to identify. This aligns with Laeli et al. (2023), who stated that misconceptions are very difficult to identify because they are not the same as a lack of conceptual understanding. Identifying misconceptions requires testing to determine student errors, which then serves as material for improving instructional delivery (Rokhim et al., 2023). There are various types of tests, such as one-tier, two-tier, three-tier, and four-tier tests. A three-tier test is a modification of a two-tier test (Laeli et al., 2023). The difference between a three-tier test and a two-tier test lies in their ability to provide appropriate reasoning accompanied by a level of confidence. This level of confidence is called the Certainty of Response Index (CRI).

The CRI was developed by Hasan, Bagayoko, and Kelley in 1999 to measure a student's confidence in answering a question (as cited in Mulyaningsih et al., 2024). The CRI method is an analytical approach that presents questions equipped with a confidence scale for answering, allowing students to provide their own answers based on their existing knowledge (Wulandari et al., 2022). A student's level of certainty is reflected in the scale provided for each question. The CRI certainly has its advantages and disadvantages. The advantage of the CRI is that it is very easy to use at every educational level, from elementary school to higher education. At the same time, its weakness lies in its reliance on student honesty (Waluyo et al., 2019). The presence of the Certainty of Response Index (CRI) is able to provide a more accurate picture of the extent to

which students truly understand a subject. Based on the pre-observation, students had misconceptions about life cycle material due to limited direct field observations, receiving only abstract information, and difficulties describing the life cycle stages.

Science in elementary school includes life cycle material that discusses perfect and imperfect metamorphosis. Animal life cycle material at SDN Sentul 3 is crucial to study because it is a fundamental concept in Science and Social Studies (IPAS). Based on the results of the pre-observation and initial interviews with the teacher, fourth-grade students at SDN Sentul 3 experience difficulties understanding animal life cycle concepts, particularly distinguishing between types of metamorphosis and the sequence of their developmental stages. This indicates the possibility of misconceptions, although it has not been definitively confirmed through further checking using diagnostic assessments. The explanation of this material is not specific enough and remains abstract.

However, students with misconceptions about this material are still found. This is in line with research by Nadhif & Utama (2023), which states that the largest student misconceptions are found in the sub-concepts of animal life cycle stages and animal life cycle examples, with a percentage of 46%, while the lowest misconception is in the types of animal life cycles at 27%. The cause of these misconceptions is the teacher's less-than-optimal approach to learning. This fact is supported by Fabilla et al. (2023), who found that misconceptions occur in force and motion material due to students' lack of attention to science concepts and the teacher's lack of optimization in the learning process. Furthermore, misconceptions can be influenced by inaccurate initial student understanding, as students memorize the material without fully comprehending the concept.

Based on descriptions of previous studies, it can be concluded that there are both similarities and differences between the present research and earlier research. The similarity between previous research and the study to be conducted is that both identify science misconceptions in elementary school students. While previous studies used essay tests without employing the CRI (student confidence level), this study utilizes a multiple-choice test accompanied by the CRI. This study uses a CRI response scale ranging from 1 to 5. A CRI of 1–2 means students answer by guessing, indicating a lack of conceptual knowledge, while a CRI of 3–5 means students answer with high confidence, indicating conceptual understanding. However, if the CRI is high but the answer is wrong, it indicates a misconception (Mukhlisa, 2021). Thus, this study will analyze misconceptions regarding the life cycles of living things using the three-tier test method.

This research was chosen because of the possibility that misconceptions regarding animal life cycle material are still present. Additionally, the varying academic abilities of students in the class were considered when identifying the levels of misconceptions. This study aims to identify misconceptions in animal life-cycle material using a Three-Tier Test among fourth-grade students at SDN Sentul 3, administered via multiple-choice questions.

METHODS

This study employs a qualitative method to observe actual field conditions. Qualitative methods are research methods used to investigate actual conditions in the field. This research uses a descriptive qualitative approach. This statement aligns with Waruwu (2023), who indicates that descriptive qualitative research aims to systematically describe existing phenomena. This study aims to determine the level of misconceptions among students, particularly regarding material on animal life cycles. This research was conducted at SDN Sentul 3 in Blitar City with fourth-grade

students. The sample in this study consisted of 23 students. The research sample was taken using the purposive sampling method. The purposive sampling method is a technique for selecting samples based on specific considerations for a particular purpose, without grouping (strata). This method was used with the permission and recommendation of the relevant school teacher.

The data collection technique used is a three-tier test. The test format consists of multiple-choice questions based on the Certainty of Response Index (CRI), accompanied by reasoning. Before the questions were tested on students, they were trialled and then analysed for validity and reliability using Anates. Out of the 25 items tested, only 13 items were valid and reliable. The questions tested consist of 13 multiple-choice items accompanied by reasons for material on animal life cycles. The instrument used is an adoption from the research by Febriana et al. (2025). The obtained data were then converted into categories of student understanding levels as shown in Table 1.

Table 1. Student Understanding Level Categories

Tier-1	Tier-2	Tier-3	CRI Value	Description	Code
Correct	Correct	Confident	>2.5	Understand Concept	PK
		Not Confident	<2.5	Understand Concept but Less Confident	PKKY
	Incorrect	Confident	>2.5	Misconception	M
		Not Confident	<2.5	Do Not Understand Concept	TPK
Incorrect	Correct	Confident	>2.5	Misconception	M
		Not Confident	<2.5	Understand Concept but Less Confident	PKKY
	Incorrect	Confident	>2.5	Misconception	M
		Not Confident	<2.5	Do Not Understand Concept	TPK

After grouping the students' level of understanding into each category, the percentage of misconceptions was then categorized based on Table 2.

Table 2. Categories of Student Misconception Percentage (Oktavia et al., 2024)

Percentage	Category
0% ≥ 30%	Low
31% ≥ 60%	Moderate
61% ≥ 100%	High

The data analysis techniques used include data reduction, data display, and conclusion drawing. Data reduction is the process of selecting and simplifying raw data from the author's field notes. Data display is a collection of organized information designed to allow for drawing conclusions and determining follow-up actions. Conclusion drawing is the effort the researcher makes to arrive at more detailed conclusions in the field.

RESULTS AND DISCUSSION

Based on the questions given to students, it was found that out of 13 items administered to 23 students, each item exhibited instances of misconceptions, conceptual understanding, conceptual understanding but less confident, and lack of conceptual understanding. The percentage for each item is presented as follows:

Table 3. Percentage of Students Understanding Concepts for Each Item

Item Number	Percentage (%)			
	Understanding Concept	Understanding Concept but Less Confident	Misconception	Do Not Understand Concept
1.	26.1	0.0	69.6	4.3
2.	30.4	0.0	52.2	17.4
3.	17.4	4.3	60.9	17.4
4.	17.4	4.3	78.3	0.0
5.	8.7	0.0	78.3	13.0
6.	17.4	0.0	78.3	4.3
7.	30.4	0.0	56.5	13.0
8.	21.7	0.0	60.9	17.4
9.	34.8	0.0	47.8	17.4
10.	21.7	0.0	65.2	13.0
11.	13.0	0.0	69.6	17.4
12.	21.7	0.0	69.6	8.7
13.	21.7	0.0	69.6	8.7

Based on Table 3, for question 1, which discusses non-metamorphosing animals, 26.1% of students understood the concept, 69.6% had misconceptions, and 4.3% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided incorrect answers with high confidence but with incorrect reasoning. The student's reasons for this item claimed that cockroaches do not undergo metamorphosis, whereas in reality, they undergo incomplete metamorphosis.

Based on question 2, which discusses perfect metamorphosis, 30.4% of students understood the concept, 52.2% had misconceptions, and 17.4% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided incorrect answers with high confidence, even though their reasoning was correct. The students' reasoning for this item stated that the stage in question involves leaf consumption. This reasoning is correct because the stage in the butterfly life cycle that causes plant damage, such as holes in leaves, is the larval stage.

Based on question 3, which discusses imperfect metamorphosis, the percentages were: 17.4% who understood the concept, 4.3% who understood but were less confident, 60.9% with misconceptions, and 17.4% who did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided the correct answer with high confidence, but their reasoning was incorrect. The students' reasoning for this item claimed that the egg-nymph-adult sequence is the adult mosquito phase. In contrast, the mosquito life cycle lacks a nymphal stage because it undergoes complete metamorphosis.

Based on question 4, which discusses perfect metamorphosis, the percentages were: 17.4% understood the concept, 4.3% understood but were less confident, and 78.3% had misconceptions. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided the correct answer with high confidence, but their reasoning was incorrect. The students reasoned that no change occurs, whereas, in reality, perfect metamorphosis involves significant physical changes.

Based on question 5, which discusses incomplete metamorphosis, the percentages were: 8.7% understood the concept, 78.3% had misconceptions, and 13% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided the correct answer with a high CRI, but the reasoning was incorrect. The students' reasoning for this item was that it was a perfect metamorphosis. In contrast, the cycle that does not undergo major changes into the adult form is actually an incomplete metamorphosis.

Based on question 6, which discusses incomplete metamorphosis, 17.4% of students understood the concept, 78.3% had misconceptions, and 4.3% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students reasoned that the cycle consists of egg, larva, pupa, and adult. In contrast, the animal stages mentioned in the question lack larval and pupal phases because they undergo incomplete metamorphosis.

Based on question 7, which discusses non-metamorphosing animals, the percentages were: 30.4% understood the concept, 56.5% had misconceptions, and 13% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item claimed that butterflies and fish do not undergo metamorphosis, while in reality, butterflies undergo perfect metamorphosis.

Based on question 8, which discusses differences in animal metamorphosis, the percentages were: 21.7% understood the concept, 60.9% had misconceptions, and 17.4% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item claimed that lizards undergo metamorphosis while bees do not. In reality, it is the lizard that does not undergo metamorphosis.

Based on question 9, which discusses perfect metamorphosis, 34.8% of students understood the concept, 47.8% had misconceptions, and 17.4% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item stated that stage one uses gills and stage two uses lungs. In reality, the correct answer is that stage 4 represents the tadpole stage, when it still uses gills, and stage 5 represents the young frog breathing with lungs.

Based on question 10, which discusses perfect metamorphosis, the percentages were: 21.7% understood the concept, 65.2% had misconceptions, and 13% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item claimed that perfect metamorphosis involves three stages. In reality, perfect metamorphosis consists of four stages.

Based on question 11, which discusses perfect metamorphosis, 13% of students understood the concept, 69.6% had misconceptions, and 17.4% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item was that it included both perfect and incomplete metamorphosis. In reality, mosquitoes and frogs undergo perfect metamorphosis because they experience significant changes in form.

Based on question 12, which discusses animal life cycle stages, 21.7% of students understood the concept, 69.6% had misconceptions, and 8.7% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item was that the animals have dissimilar forms. In reality, the correct answer is that cows, goats, and rabbits do not undergo metamorphosis.

Based on question 13, which discusses perfect metamorphosis, 21.7% of students understood the concept, 69.6% had misconceptions, and 8.7% did not understand the concept. In this question, the highest percentage lies in the misconception category. Based on the analysis results, students provided an incorrect answer with high confidence, along with incorrect reasoning. The students' reasoning for this item claimed that the caterpillar is in the egg stage. In reality, the caterpillar is in the larval stage.

The questions presented are still randomized by sub-concept. When organized by sub-concept, the numbers of students who understood the concept, experienced misconceptions, and did not understand the concept are detailed in Table 4 below.

Table 4. Average Percentage of Students Understanding Concepts Per Sub-Concept

Sub-Concept	**Item Number**	**Percentage (%)**			
		Understanding Concepts	Understanding Concepts but Less Confident	Misconceptions	Not Understanding Concepts
Perfect metamorphosis	2	30.4	0.0	52.2	17.4
	4	17.4	4.3	78.3	0.0
	9	34.8	0.0	47.8	17.4
	10	21.7	0.0	65.2	13.0
	11	13.0	0.0	69.6	17.4
	13	21.7	0.0	69.6	8.7
Average		**23.2**	**0.7**	**63.8**	**12.3**
Incomplete metamorphosis	3	17.4	4.3	60.9	17.4
	5	8.7	0.0	78.3	13.0
	6	17.4	0.0	78.3	4.3
Average		**14.5**	**1.4**	**72.5**	**11.6**
Non-metamorphosing animals	1	26.1	0.0	69.6	4.3
	7	30.4	0.0	56.5	13.0
Average		**28.3**	**0.0**	**63.1**	**8.7**
Animal life cycle stages	12	21.7	0.0	69.6	8.7
Average		**21.7**	**0.0**	**69.6**	**8.7**
Differences in animal metamorphosis	8	21.7	0.0	60.9	17.4
Average		**21.7**	**0.0**	**60.9**	**17.4**

Based on Table 4, the percentages for students who understand the concept, understand but are less confident, have misconceptions, and do not understand the concept are identified. In item

number 9, students achieved the highest conceptual understanding at 34.8%, indicating that the material relates to familiar animal examples in daily life. Conversely, item number 5 showed the lowest conceptual understanding at 8.7%, indicating difficulties in grasping specific details within the incomplete metamorphosis sub-concept. The high misconception rate, reaching 78.3% in items 4, 5, and 6, reflects confusion in distinguishing metamorphosis phases, particularly between perfect and incomplete metamorphosis, which are often perceived as visually similar. Furthermore, in item number 4, no students were found in the "do not understand concept" category (0%), yet the misconception rate was very high; this means students felt confident in their answers even though they were scientifically inaccurate.

The perfect metamorphosis sub-concept is contained in items 2, 4, 9, 10, 11, and 13. The high average misconception rate of 63.8% compared to the 23.2% conceptual understanding rate indicates that students actually have an idea of perfect metamorphosis, but construct erroneous thoughts, often due to overgeneralizing that all insects that change form pass through a pupa phase. The low percentage of students who understood the concept but were less confident (0.7%) and the total lack of understanding suggest that students feel confident with their logic but fail to distinguish specific details between perfect and incomplete metamorphosis.

The incomplete metamorphosis sub-concept is contained in items 3, 5, and 6. The misconception rate of 72.5% dominates due to students' cognitive failure to identify the absence of a pupa phase, where they tend to force the more popular perfect metamorphosis scheme onto the life cycles of all insects. The low level of conceptual understanding (only 14.5%) and the 1.4% rate of students who understood the concept but were less confident indicate that students have a strong belief in that incorrect understanding, assuming every change in animal form must pass through larval and pupal stages without realizing the existence of a nymph phase that resembles the parent. Meanwhile, students who did not understand the concept amounted to 11.6%.

The non-metamorphosing animal sub-concept is found in items 1 and 7. The high misconception rate of 63.1% results from students' tendency to assume that every animal must undergo a drastic change in form during its life cycle; thus, they often misidentify body size growth in animals as a metamorphosis. The low percentage of students who did not understand the concept (8.7%) compared to those who understood the concept (28.3%) shows that students actually feel they have knowledge about the life cycles of animals like cats or chickens. Yet, they are trapped by an erroneous definition of what distinguishes ordinary growth from true metamorphosis. This phenomenon indicates that these items successfully revealed a student mindset that equates the developmental processes of all living creatures with the term metamorphosis.

The animal life cycle stages sub-concept is contained in item 12. On average, students had a 69.6% misconception due to their failure to accurately sequence biological development, leading them to misunderstand transitions between life phases. The low percentage of students who did not understand the concept (8.7%) compared to those who understood the concept (21.7%) shows that most students actually feel familiar with growth terms but possess flawed logic in connecting the links of the life cycle. This dominant misconception is often triggered by the use of rote memorization without a deep understanding of biological functions at each stage, leading students to feel confident in their answers even though the sequences they construct do not scientifically match the reality of the animal development being questioned.

Furthermore, the differences in animal metamorphosis sub-concept are contained in item 8. This item is characterised by a misconception rate of 52.2% due to students' cognitive difficulties in distinguishing among various types of animal development, with students focusing

only on the final growth outcome rather than the transition process. The low percentage of conceptual understanding (only 21.7%) compared to the lack of conceptual understanding (17.4%) indicates that most students have a basis of information regarding the material, but fail to analyze specific characteristics between one type of metamorphosis and another. This phenomenon indicates that item number 8 demands higher-order thinking skills to distinguish technical details often considered similar by students, causing them to be trapped in mistaken beliefs regarding the biological development mechanisms of the animals being questioned.

Table 5. Average Percentage of Students Understanding Concepts

No.	Category	Percentage (%)
1.	Understanding Concept	21.7
2.	Understanding Concept but Less Confident	0.7
3.	Misconception	65.9
4.	Do Not Understand Concept	11.7

The results of the data analysis regarding the overall level of student understanding are shown in Table 5. Based on Table 5, it can be seen that 21.7% of students understood the concept, 0.7% understood it but were less confident, 65.9% had misconceptions, and 11.7% did not understand the concept. It was found that students experienced the most misconceptions in the animal life cycle material, with a percentage of 65.9%. In the second position with the highest percentage, students understood the concept at 21.7%. The third position was students who did not understand the concept, with a percentage of 11.7%. The last position was students who understood the concept but were less confident, with the smallest percentage of 0.7%. Below are the questions containing misconceptions presented in Figures 1, 2, and 3.

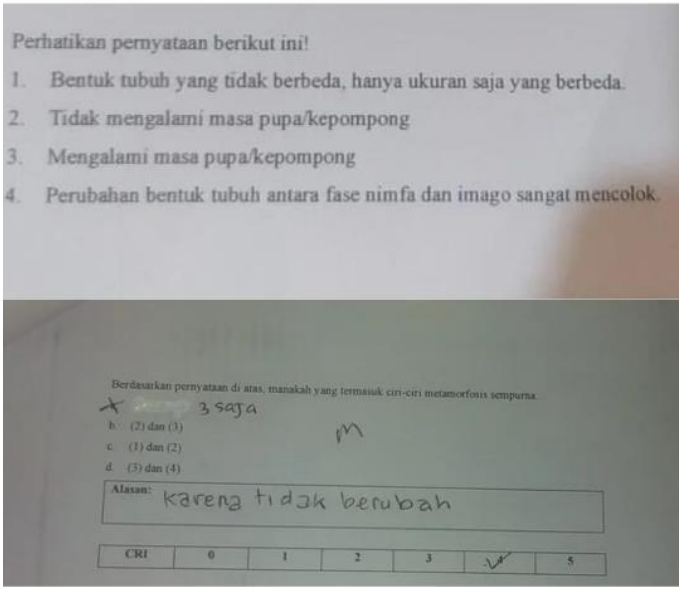


Figure 1. Answer Results for Question Number 4

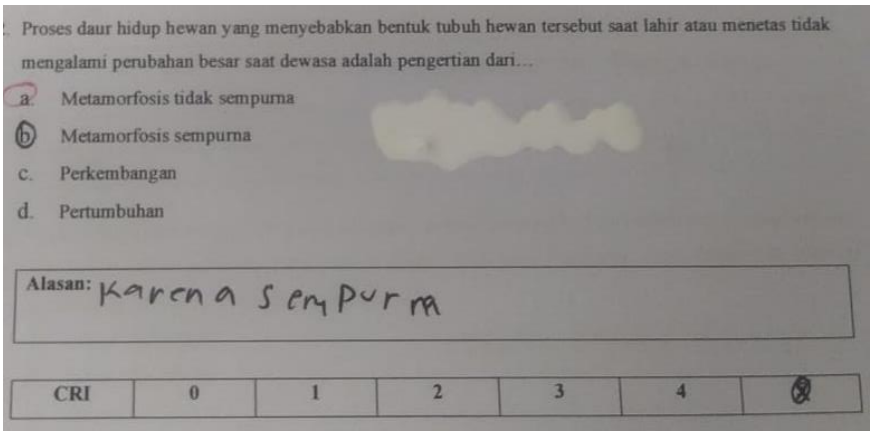


Figure 2. Answer Results for Question Number 5

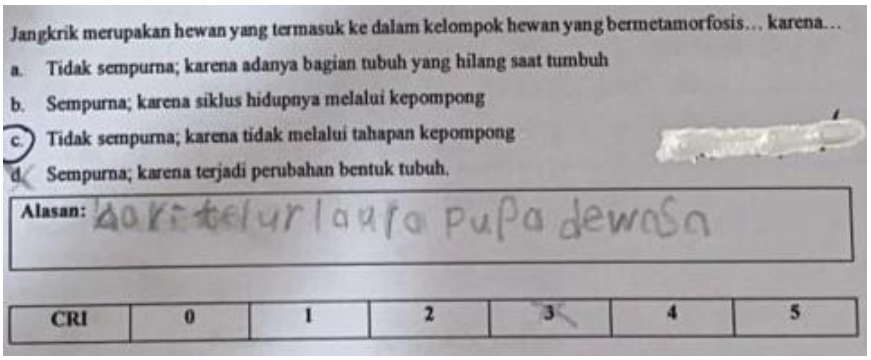


Figure 3. Answer Results for Question Number 6

The answer results shown by the students varied from one another. The students' answers in Figures 1, 2, and 3 above prove that several students still experience misconceptions. The students' errors in Figures 1, 2, and 3 can be grouped into several main causes that contribute to such high misconception rates. First, students often engage in overgeneralization by assuming all insects must have a cocoon (pupa) because that is the example they most frequently hear. Second, misinterpreting a word, where students think the word "perfect" (sempurna) means the form does not change further from birth. Third, many students merely memorize without understanding; thus, they may choose the correct answer in the multiple-choice section but write the incorrect sequence when providing a reason. Based on item 4, it is known that students answered correctly that perfect metamorphosis involves a pupa phase. Metamorphosis involves a pupa phase, whereas [imperfect] metamorphosis does not experience this phase (Dzakiyah et al., 2025). However, the reasoning was incorrect because they assumed no change occurs, while in reality, perfect metamorphosis involves significant changes in form. Meanwhile, based on item number 5, it is known that students' answers were incorrect because they answered "perfect metamorphosis." In contrast, the life cycle process where the animal does not undergo major changes into its adult form upon hatching is incomplete metamorphosis. Incomplete metamorphosis does not involve a form change that is too different from birth to adulthood (Desmita & Aryani, 2025).

Furthermore, based on item number 6, it is known how students responded to the form of metamorphosis in crickets along with the appropriate reasoning. Most students did not correctly

answer that the cricket's metamorphosis is perfect. The correct answer is that crickets have an incomplete metamorphosis because they do not pass through a pupal stage. Incomplete metamorphosis only involves 3 stages of growth: egg, nymph, and adult (Lado et al., 2020). Based on the observations, several students were still asking the teacher about the differences between perfect and incomplete metamorphosis.

Discussion

Observation results revealed that some students remained confused while completing the test, as evidenced by their asking one another questions. However, several other students appeared calm during the process. This phenomenon is related to the transition to the Kurikulum Merdeka, where Learning Outcomes (*Capaian Pembelajaran/CP*) demand deep independent understanding, yet this is often not accompanied by adequate learning resources. Current Kurikulum Merdeka textbooks run the risk of becoming new sources of misconceptions because the material presented tends to be very concise; consequently, students often fill in information gaps using logic that is not necessarily accurate. From the multiple-choice answers, it was found that the highest number of student misconceptions occurred in the perfect metamorphosis sub-concept (item 4) and the incomplete metamorphosis sub-concept (items 5 and 6). Based on these answers, some students still have not mastered the material on perfect and incomplete metamorphosis.

Based on observations, students' understanding of animal life cycle material, particularly in the incomplete metamorphosis sub-concept, is considered insufficient. The highest misconception rate of 72.5% in the incomplete metamorphosis sub-concept indicates a cognitive failure in the form of prototype generalization, where students apply the butterfly life cycle to all types of insects and tend to ignore the differences between the nymph and pupa phases. This finding aligns with Halimah et al. (2025), who stated that insect metamorphosis often falls into the category of overgeneralization because some insects do not undergo significant metamorphosis. A lack of material understanding can lead students to experience misconceptions (Andini & Kurniawati, 2024). The novelty of this study lies in revealing that the simplified nature of the Kurikulum Merdeka textbooks, intended to promote independent learning, inadvertently becomes an incubator for high-certainty misconceptions. Unlike previous studies that focus on teacher-centered errors, this research highlights how students actively construct flawed logical structures to fill informational gaps in concise curriculum materials.

The misconceptions occurring among fourth-grade students at SDN Sentul 3 are caused by several factors, including students only memorizing concepts and frequently forming their own assumptions. These assumptions arise because many students hold their own concepts that do not conform to the correct scientific definitions. Misconceptions can also result from learning that relies too heavily on textbooks, as noted by Galistiani & Fatmahanik (2023). The CP used in this study—"Students can create simulations using simple charts/tools regarding the life cycle of living things"—requires a level of knowledge that students may lack if information is not adequately stimulated. As a result, they may guess and fall into incorrect knowledge. Teachers can address this by providing more detailed explanations and implementing innovations, such as contextual methods that have students observe animals directly to collect valid information.

Students have limited knowledge if information and knowledge are not presented and stimulated for them. As a result, they will only guess and eventually fall into incorrect knowledge. Misconceptions can be addressed by teachers providing more detailed explanations of the material so that all students understand it, rather than relying solely on books. Teachers can implement

learning innovations to help students better understand the material. Innovation can be achieved through contextual methods, where students can observe several animals to collect valid information. Furthermore, misconceptions can be categorized by their origin: first, from the students themselves due to incorrect intuition, weak memory, or ineffective teacher learning styles (Nasution et al., 2021); second, from drawing wrong conclusions due to a lack of thorough conceptual mastery (Riti et al., 2022); and third, from inappropriate learning support media or non-meaningful instruction (Nurfiyani et al., 2020). In the case of SDN Sentul 3, students struggle because they do not fully master the concepts, leading to misunderstandings of animal life cycles.

Despite the insights gained, this study is limited by its small sample size of 23 students from a single school, which restricts the generalizability of the results. However, the unique finding—specifically the high rate of misconceptions linked to the simplified nature of the Kurikulum Merdeka textbooks—offers a new perspective for educational practitioners. This suggests that pedagogical innovation must move beyond reliance on texts toward more contextual, hands-on biological observations to bridge the conceptual gaps identified. Future research should incorporate a larger, multi-site population and employ clinical interviews to explore the internal cognitive processes behind these persistent misconceptions more deeply.

CONCLUSION

Based on a study of fourth-grade students, it is concluded that misconceptions remain a significant barrier to science education, particularly in the animal life cycle material. Quantitatively, the average misconception rate reached 65.9%, with the incomplete metamorphosis sub-concept showing the highest error rate at 72.5%. These findings reveal that students tend to overgeneralize the butterfly life cycle (perfect metamorphosis) to all insect species, leading to a failure in identifying the nymph phase. This cognitive gap is further exacerbated by the concise nature of the Kurikulum Merdeka textbooks, which often lack the depth required for students to build accurate scientific mental models independently.

Several recommendations are proposed based on these findings. Teachers should move beyond textbook-heavy instruction by providing more detailed, context-rich explanations and using advanced visualization tools, such as Augmented Reality (AR) or physical dioramas on Smartboards, to make abstract biological concepts more concrete. Furthermore, since this study was limited to a small sample from a single school, future research should examine larger, more diverse populations. It is also recommended that subsequent studies employ qualitative clinical interviews further to investigate the deep-seated cognitive origins of these persistent misconceptions.

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