The Types and Causes of Misconceptions about the Circulatory System in Madrasah Ibtidaiyah Negeri of Pontianak City

Angga Bayu Segara, Kartini, Vidya Setyaningrum*

Pendidikan Guru Madrasah Ibtidaiyah, Fakultas Tarbiyah dan Ilmu Keguruan, Institut Agama Islam Negeri, Pontianak, Indonesia

*Corresponding author's email: vidyasetyaningrum@iainptk.ac.id

Article History:
Received date: May 9 2024
Received in revised from: June 11 2024
Accepted date: June 15 2024
Available online: June 19 2024

Citation:
Segara, A.B., Kartini, & Setyaningrum, V. 2024. The types and causes of misconceptions about the circulatory system in Madrasah Ibtidaiyah Negeri of Pontianak City. JIPI (Jurnal IPA dan Pembelajaran IPA), 8(2):143-155.

Abstract. The background of this study arose from the need to identify and overcome barriers to understanding crucial concepts in the human circulatory system. This study aims to describe the profile of students’ misconception about the blood circulatory system and their causes in MIN-Kota Pontianak consisting of MIN 1 Pontianak City, MIN 2 West Pontianak, MIN 3 Southeast Pontianak and MIN 1 Filial East Pontianak. The research method used a descriptive quantitative approach with a population of all grade VI students. Sampling was done with a proportionally stratified random sampling technique. Data collected using two-tier tests and semi-structured interviews. The research showed that misconception rate in Madrasah Ibtidaiyah throughout Pontianak City is 47.3%. Results also showed that students’ misconception profile consists of: a) incorrect understanding of the role of the lungs. b) The function of the foyers and the chambers of the heart. c) incorrect understanding of the difference in the function of blood vessels in the heart and throughout the body. d) incorrect understanding of the role of capillary vessels in the circulatory system. The causes of misconceptions are: a) Inaccurate or inappropriate sources of information, b) The lack of clarity of concepts in the delivery of the material, c) The continuation of the previous class’s understanding, d) Random answers or guessing also play a role in the occurrence of misconceptions.

Keywords: Misconceptions, Circulatory System, Elementary

Introduction

In the learning process of Natural Sciences, there are often various misconceptions that can hinder students' understanding of the material being taught. Irianti (2021) states that misconception is an understanding of concepts that is opposite or contrary to the understanding generally accepted by scientists. Aziz & Akram (2022) also states that concepts formed without a prior understanding of the subject aren't always incorrect, although they may be considered misconceptions. While science is classified as a subject with a field of misconceptions that exist in all levels of education starting from elementary school to college (Suparno, 2013). At the elementary school level, several misconceptions were found that occurred in science subjects, including misconceptions in photosynthesis material (Dwilestari & Desstya, 2022); the basic concepts of force and motion (Munastiwi et al., 2022; Nasution et al., 2021; Resblantoro & Nugraha, 2017; Yuliati, 2017); heat and
Based on brief interviews in initial observations when collecting data, there are many things that affect students' concept understanding of the circulatory system material. The initial conceptual errors in the circulatory system material are in the students' errors in arranging the sequence of the circulatory system, misunderstanding the function of the chambers, and classifying the lung organ as an organ of the circulatory system. In field conditions, researchers also found arguments from educators who stated that as long as students' scores were high, conceptual errors would never exist. But basically, the right learning and education process will help humans recognize, understand, and retain a learning concept until it becomes knowledge as an integral part of their identity as a learner in understanding a lesson (Segara et al., 2023).

Based on this, high scores on students do not guarantee students in mastering the material and understanding a concept. Referring to the findings of (Segara & Setyaningrum, 2024) research that discussed the validity and reliability of the Two-Tier Test as a basis for understanding misconceptions, this research further focuses on an in-depth understanding of students' misconceptions on the blood circulatory system material at MIN in Pontianak City. By integrating the results of previous research, the purpose of this point is to harmonize and continue the understanding of the quality of measuring instruments and provide a more specific context related to misconceptions that can be faced by students. Product development is needed to make it easier for educators to evaluate and analyze data needs in exploring the problems that students have (Jaya, 2022).

To overcome misconceptions, it is necessary to first identify misconceptions of students. According to Nasution, (2021) the essential step in the research is to identify and overcome learners' misconceptions on the material of the circulatory system, to improve their understanding of the function and important role of the circulatory system in maintaining a healthy body. The next step is to identify the misconceptions that often occur in the concept. According to Yusra et al. (2021), misconceptions will be identified through observations, interviews, tests, and relevant literature studies. After identification, the data will be analyzed using qualitative analysis method.

Researchers will develop recommendations based on data analysis to address misconceptions, with the hope of having a positive impact on learning. The final step involves evaluating the recommendations through observing changes in learner behavior or measuring improvements in understanding through tests, particularly at the primary school level. This study explored misconceptions on the topic of the circulatory system at MIN in Pontianak city. Sub-problems involved the profile of misconceptions and identification of their causes. The general research objective was to gain an in-depth understanding of misconceptions on the topic of circulatory system in MIN of Pontianak city, with the hope of providing insights that contribute to the development of teaching methods and learners' understanding. The purpose of this research is to describe the misconception profiles and identification of factors causing misconceptions in the circulatory system material.

**Methods**

This research is descriptive quantitative. According to Sugiyono (2022), descriptive quantitative research has the aim of describing the characteristics of the variables or phenomena under study, both through primary data collection and secondary data. Jayusman & Shavab (2020), also explained that descriptive quantitative research is
referred to as research that will be carried out to achieve the goal of knowing the value of a variable related to the event under study, at least one without correlating with other variables. Sugiyono (2022), explained that the population includes various items, including living organisms, objects, diseases, test scores, and events.

The population of this study is all 6th grade students in MIN in Pontianak City. In this research, the proportional stratified random sampling method was used to select samples of students from each MIN in Pontianak City. This technique is referred to as a random sampling method that divides the population into several groups commonly referred to as strata (Sugiyono, 2022). This sampling means that the number of samples from each stratum that has been taken is proportional to the size of the strata in the population. The population of this study were all students in MIN Pontianak City class VI. This was done because researchers took samples of students who had already received material on the circulatory system. In the process of this proportional stratified random sampling method, the first thing that can be done is that researchers divide the population of students at MIN Pontianak City based on their school. Where MIN 1 and Filial mile both consist of 4 classrooms, while MIN 2 consists of 5 classes and MIN 3 consists of 2 classes. After that from each school, researchers took samples randomly proportionally based on the number of classes in the school. So 2 classes were randomly selected in MIN 1, MIN 2 and filial MIN, and 1 class in MIN 3.

The data collection techniques used in this research are observation, two tier tests, interviews, and documentation. Habellia et al. (2021), explains that the two-tier test is a diagnostic test that has a two-level question format. The first level offers four answer choices, while the second level displays four reasons that support the answer on the first level. Two tier test used in this research offers four level choices on the first level, but using open-ended responses on the second level. Then the researcher will strengthen the data with interviews using interview guidelines as tool for interaction as well as documents obtained from checklists or smartphones as data reinforcement. Data analysis was carried out by analyzing the responses of learners' responses and were described to illustrate the extent to which misconceptions were are spread and the factors that influence them. Data analysis was carried out using statistic descriptive by calculating frequency, percentage, average, and graph.

**Results and Discussion**

This study focused on the type of misconception of students in MIN in Pontianak City, with a graph for each MIN to show the level of misconceptions in each MIN in Pontianak City. The results showed significant variation in learners' performance between MIN 1, MIN 2, MIN 3, and MIN 1 Filial on the misconception indicators. Based on the results of the two-tier test on the circulatory system and the analysis of learners' reasons for answering, it appears that misconceptions and inaccurate understanding of these concepts are the main challenges for learners. In general, there are 47.3% of students in all MIN in Pontianak City who experience misconceptions on the material of the circulatory system that can be seen on Figure 1.
Based on the graph, it can be seen that MIN 1 has the highest misconceptions with 50.1%, followed by MIN 3 with 46.9%, MIN Filial with 46.2% and MIN 2 with 46.1%. The misconceptions mainly appeared in the concepts of the role of the lungs, the function of the chambers and the chambers of the heart, the difference in the function of blood vessels in the heart and throughout the body, the role of capillary vessels, and the sequence of major and minor circulatory processes.

Based on the test results and interviews with learners at all MIN in Pontianak City regarding their understanding of the human circulatory system, it can be concluded that there are misconceptions and inaccurate understanding in several crucial knowledge indicators. This inaccurate understanding is also in accordance with the views of Yuliati (2017), which reveals that misconceptions should not be interpreted as the right concept and must be realized early so that students do not dissolve in misunderstanding the concept. The following is a description of the school data.

**Figure 1. Misconception in each MIN**

**Figure 2. Misconception in each aspects at MIN 1 Pontianak City**

In the final results of the research at MIN 1 itself had a final result of 50.1% of learners having misconceptions. Based on the results of answers, interviews and learners’ reasoning in answering test questions about the circulatory system, related to the knowledge indicator about the role of the lungs, misconceptions and inaccurate understanding of these concepts were seen. In indicator A, learners showed incorrect understanding, such as linking the lungs to the circulatory function without sufficient understanding or even referring to the role of the brain without sufficient knowledge base. Striking misconceptions were seen, such as the perception that the lungs act as a...
circulatory organ or filter out impurities in the blood. Resbiantoro & Nugraha (2017), also highlighted that misconceptions can be overcome by paying more attention to the learning process.

In indicator B, which tests understanding of the functions of the chambers and the chambers of the heart, learners show misconceptions especially related to the disturbances in individuals suffering from heart disease. There were misconceptions about the functions of the left and right chambers, and some learners believed that it was the left chambers that were disrupted, when in fact it was the right chambers that pumped blood throughout the body (Zubaidah et al., 2017). Learners’ reasoning related to the question about which part of the heart is disrupted during heart disease revealed misconceptions, and the conclusion highlights the need for clarification about the unique functions of each part of the heart.

Indicator C, which assesses whether blood vessels in the heart and the rest of the body have the same function, shows that the majority of learners think they have similar functions. Some learners associated the blood vessels in the heart with transporting blood to the lungs, while those in the rest of the body transport oxygen and nutrients. This misconception can be overcome by providing more specific directions to convey that the heart’s job is only to pump blood throughout the body, and that the task of transporting blood throughout the body is blood vessels (Setiadi, 2020).

In indicator D, which tests whether learners have an understanding of the role of capillaries in the circulatory system, there are misconceptions mainly related to the understanding that capillaries only connect arteries and veins. But actually another task of capillaries is as a container for gas exchange in the body (Zubaidah et al, 2017). Finally, in indicator E, which tested learners’ understanding in sequencing the major and minor blood circulation processes, there were variations in understanding. Most learners have a uniform understanding, but there are variations in answers that indicate confusion or different interpretations. Further emphasis on the concept is needed in learning to ensure consistent understanding among learners (Nasution et al., 2021).

![Figure 3. Misconception in each aspects at MIN 2 West Pontianak](image)

Based on the results of interviews and tests of learners related to their understanding of the role of the lungs in the circulatory system, it can be concluded that the majority of them have a wrong understanding. Most learners believe that the main function of the lungs is to filter out impurities in the blood, and some of them even confuse the role of the lungs with the circulatory system and call it a blood pump. Although a small number mentioned that the lungs can produce red blood cells, the misconception is still very visible. Izza et al. (2021), stated that undirected learning from various sources that are difficult to
test for credibility can lead to a mixture of pure knowledge and abstract understanding of students, creating new concepts that move away from the main concept.

Based on learners' responses to questions regarding the lungs' response to breathing, it appears that the majority of their knowledge comes from various sources, such as teacher explanations, learning materials in grade 5, reading literature, and information from media such as YouTube (Fridatama et al., 2021). Where Mieke et al. (2019), also revealed that teachers and learning resources can trigger misconceptions if they do not have sufficient ability in the field being taught. Although most learners state that the lungs play a role in taking in oxygen from the air during breathing, some may not fully understand the core of the question, which focuses on what the lungs inhale. Therefore, a more detailed and clear approach to learning is needed to ensure accurate understanding of the breathing process (Nurulwati et al., 2014). It is important to emphasize that the lungs play a role in taking in oxygen from the air during the process and keep the focus on the essence of the question. The majority of learners obtain key information on the role of the lungs in the circulatory system from teacher explanations, learning in grade 5, theme book readings and educational videos on various platforms. While most can recognize the role of the lungs as providing oxygen to body cells, a minority may need further prompting to provide more specific reasons.

The majority of learners were able to correctly identify that the right chambers of the heart are affected in people with heart disease, but a small number of learners still needed further understanding, indicating potential for improvement in this concept. Toto et al. (2019), emphasize that improving scientific attitudes and correcting misconceptions can be realized through a more focused learning approach to ensure accurate and in-depth understanding of the role of the porch and chambers in the blood pumping function of the heart.

Based on learners' responses to the question about the part of the circulatory system that plays a role in stopping skin bleeding, some learners mentioned arteries as the answer. Reference sources included classroom learning, teacher explanation, reading books, and watching videos on YouTube and TikTok. Although the majority gave the excuse of not knowing or forgetting, this indicates difficulty in understanding the question (Dewi & Ibrahim, 2019a). Therefore, a more focused learning approach is needed to ensure consistent and in-depth understanding of the role of arteries, veins and capillaries in the circulatory system, especially in the context of stopping bleeding on the skin. The majority of learners stated ignorance as the reason related to the question on excessive blood viscosity and blockage of blood vessels. Some referred to various sources of information, including books, videos, teacher explanations, and experiences in grade 5. Learners' ignorance is also caused by the complexity of the concepts learned, not packaged in simple language, and can trigger misconceptions (Ardiyanti & Utami, 2018). A more focused learning approach is needed to ensure a consistent and clear understanding of the role of veins and arteries in the context of blood viscosity, with the aim of improving holistic understanding of the concept.

On indicator C, which assesses learners' understanding of the difference in the function of blood vessels in the heart and throughout the body, the majority had difficulty understanding the difference. Excuses such as ignorance, random answers, and forgetting were typical in learners' responses. Although some learners referred to previous learning, such as in grade 5 or through online resources, further emphasis was needed on understanding that blood vessels in the heart play a role in circulating blood throughout the body, while blood vessels throughout the body carry blood back to the heart (Subekti, 2017). This conclusion suggests the need for additional efforts to ensure a deeper and more accurate understanding of this concept. Most learners also had a lack of
understanding about the function of coronary blood vessels in the heart, with the majority stating that they did not know or giving a basic answer. Only one learner realized that the coronary blood vessels are located in the heart. Further emphasis on understanding that the main role of coronary blood vessels is to supply oxygen and nutrients to the heart muscle, not to the rest of the body, is needed for the concept to be better understood (Subekti, 2017). On the question of the role of capillary vessels in the human circulatory system, the majority of learners expressed ignorance, while some referred to learning from student worksheets (LKS) and the internet. Additional learning and concept reinforcement is needed to ensure that learners have a correct understanding of the essential role of capillary vessels in the circulatory system (Zubaidah et al, 2017). Learners' understanding of the function of capillary vessels needs to be improved, and clarification of the main function of capillary vessels as the site of substance exchange between blood and body tissues is also needed.

In indicator D, which tests whether learners have an understanding of the role of capillaries in the circulatory system, there are misconceptions, especially related to the understanding that capillaries only connect arteries and veins. It should be noted that the role of capillaries is not just connecting arteries and veins, but also as a gas supply channel between the bloodstream and the body’s flow (Zubaidah et al, 2017:265). The last question, regarding the role of capillaries in blood circulation, the majority of learners showed inaccurate understanding, with many of them expressing ignorance, forgetfulness, and giving arbitrary answers. Further clarification on the main function of capillary vessels is needed, emphasizing that capillary vessels connect arteries and veins, not just the aorta and arteries in line with the opinion expressed by Ardiyanti & Utami (2018), ignorance and the like can occur because learners do not understand the concepts learned with various factors such as complicated delivery language and so on. A small number of learners noted prior learning, either in grade 5, reading the LKS book, or through online sources. In the context of learners' understanding of sequencing the major and minor circulatory processes, it was seen that the majority of them stated that they did not know, guessed and did not remember this process. A small number of them referred to sources such as reading LKS books, learning in grade 5, and watching TikTok and YouTube. Further emphasis is needed on knowledge of the function and role of each part in the circulatory system to provide a more intense understanding (Mukhlisa, 2021). Therefore, further emphasis is needed on knowledge of the function and role of each part in the circulatory system to provide a more in-depth and holistic understanding. In the interview process with students, many admitted to answering by guessing, relying on grade 5 memories, or accidentally learning the material through animations and social media. Some also learned in Figure 5, but had difficulty understanding the concepts. Therefore, a more interactive and in-depth learning method is needed to improve their understanding of the circulatory system concepts. This can be achieved by placing special emphasis on clarifying problematic concepts and presenting learning materials in a more structured and detailed manner (Nurulwati et al., 2014). The complexity of information sources, including teacher explanations and social media, suggests the need for further consideration in understanding learners' understanding (Yolanda, 2021).
The interview results showed conceptual errors in learners' understanding of the human circulatory system. Many of them misinterpreted the function of the lungs, thinking that the lungs are directly involved in pumping blood. In fact, the lungs only supply oxygen to the blood through body tissues and are not directly involved in pumping blood. Therefore, a more focused learning approach is needed to correct this concept (Subekti, 2017). There is also a lack of understanding of the role of blood vessels, especially the difference between large and small blood vessels. Learning recommendations include the use of diverse learning resources, interactive methods such as experiments or simulations, and emphasis on difficult concepts such as the role of capillary vessels (Zubaidah et al., 2017). Misconceptions also arose in the question about blockage of blood vessels, so a more focused learning approach is needed so that learners understand the roles of arteries, veins and capillaries consistently. Continuous evaluation is recommended to monitor learners' progress, and revision of teaching materials is recommended to convey concepts more clearly, reinforce understanding of basic concepts, and emphasize concepts that are difficult to understand (Zubaidah et al., 2017). With an improved learning approach and a focus on understanding the right concepts, it is expected that learners can develop a better understanding of the human circulatory system (Ariyastuti & Yuliawati, 2017).

Interviews with learners about the circulatory system revealed misconceptions and inaccurate understanding of key concepts. For example, some learners thought that the lungs act as a blood pump, which needs to be corrected through a more focused and clear learning approach (Dewi & Ibrahim, 2019a). This misconception may arise due to the use of similar language in some discussions, such as "pumping blood" and "breathing gas," which may lead learners to think of the lungs and heart as one in the circulatory system.
Learners' sources of information vary, including teacher explanations, learning in Grade 5, book readings, and social media such as YouTube and TikTok (Toto et al., 2019). A key recommendation is to implement more interactive, in-depth and focused learning methods to ensure accurate understanding of the circulatory system concept (Toto et al., 2019). Many learners give perfunctory answers or refer to grade 5 memories without deep understanding, perhaps due to overuse of platforms without credibility. Therefore, the role of the teacher as a reliable source of information needs to be strengthened, and the use of learning resources including books, videos and online resources can support learners' understanding.

The causes of learners' misconceptions in their understanding of the circulatory system can be identified from several aspects, including sources of information, concept vagueness, and cognitive barriers. Some of the causes of misconceptions and sources of misconceptions include:

1) Sources of Inaccurate Information: Learners may obtain inaccurate information from various sources, including the teacher's explanation (Toto et al., 2019).
2) Concept Clarity: Lack of concept clarification can trigger misconceptions (Ardiyanti & Utami, 2018).
3) Confusion in Material Delivery: This may be caused by a less effective or less structured way of delivering the material (Vidiyauni et al., 2021).
4) Memories from Grade 5 that lack depth: They only rely on information received without deep understanding (Wahyuningsih, 2016).
5) Random or Guessing Answers: This may indicate that they may not have a solid understanding of the concepts (Ardiyanti & Utami, 2018).

Addressing misconceptions in learners involves several steps:

1) A More Focused Approach to Learning: Implement a more focused and in-depth learning approach for any concepts that are difficult to understand, such as the role of the lungs, the function of the chambers and chambers of the heart, and the circulatory process (Yuliati, 2017).
2) Reinforcement of Information from Accurate Sources: Encourage learners to refer to accurate and reliable sources of information, such as textbooks, verified online sources, and clear teacher explanations (Lupita, 2018).
3) Continuous Evaluation and Adjustment: Teachers can monitor learners' understanding and adjust teaching methods according to their needs (Nasution, 2021).
4) Concept Clarification: Using concrete examples or simulations can help learners visualize the concept (Muakhirin, 2014).
5) Structured Material Provision: Presents learning materials in a more structured and detailed manner, ensuring that each stage of learning provides a thorough understanding (Dwilestari & Dessty, 2022).
6) Interactive Engagement: With the right and consistent approach, it is expected that learners can overcome their misconceptions and gain a better understanding of the human circulatory system (Izza et al., 2021).

The misconceptions that occur in students indicate that there is confusion and unclear concepts in their understanding of the circulatory system. Therefore, improvements in learning approaches are essential to overcome these misconceptions. Izza et al. (2021), also states that students tend to understand based on everyday life without confirming the truth, illustrates that inaccurate or inappropriate sources of information can be the cause of misconceptions. Recommendations to strengthen the teacher's role as a reliable source of information and use verified learning resources can help overcome this problem (Dewi & Ibrahim, 2019). Teachers should also consider learners' preconceptions before starting the learning process, especially for concepts that are prone to misconceptions.
(Setyaningrum, 2016; Setyaningrum & Sopandi, 2021). Setyaningrum & Sopandi (2021), also found that by using the right textbook, learners can correct their misconceptions with just a reading task. Highlighting the importance of improving understanding of science concepts as a solution to overcome misconceptions. Conclusions from learner interviews and tests on the circulatory system confirm the need for more focused, interactive and in-depth learning approaches. Clarification of concepts, reinforcement of information from accurate sources, and continuous evaluation were identified as steps to ensure deep understanding.

**Conclusion**

Based on these findings, it can be concluded that the misconception profile of students at MIN in Pontianak City involves inaccurate understanding of various aspects of the circulatory system material with a percentage of 47.3%. Results also showed that students' misconception profile consists of: a) incorrect understanding of the role of the lungs. b) The function of the foyer and the chambers of the heart. c) incorrect understanding of the difference in the function of blood vessels in the heart and throughout the body. d) incorrect understanding of the role of capillary vessels in the circulatory system. The causes of misconceptions are: a) Inaccurate or inappropriate sources of information, b) The lack of clarity of concepts in the delivery of the material, c) The continuation of the previous class's understanding, d) Random answers or guessing also play a role in the occurrence of misconceptions.

**References**


Segara et al.: The Types and Causes of Misconceptions about the...


154 | JIPI (Jurnal IPA dan Pembelajaran IPA), 8(2), p.143-155, (2024)


