

# Analysis Misconceptions Middle School Students in Padang Barat on Temperature, Heat and Expansion Material Use Instrument Four Tier Test

Siti Maryam<sup>1</sup>, Khairil Arif<sup>1\*</sup>, Azza Nuzullah Putri<sup>1</sup>, Rani Oktavia<sup>1</sup>, Nellisma<sup>2</sup>, Deni Angraini<sup>3</sup>

<sup>1</sup> Natural Science Education Department, Universitas Negeri Padang, Indonesia.

<sup>2</sup> SMP Negeri 2 Padang, Padang, Indonesia.

<sup>3</sup> SMP Negeri 3 Padang, Padang, Indonesia.

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Corresponding Author:

Khairil Arif

[khairilarif@fmipa.unp.ac.id](mailto:khairilarif@fmipa.unp.ac.id)

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**Abstract:** The aim of this research is to determine the profile of junior high school students' misconceptions regarding temperature, heat and expansion in Padang Barat sub-district. The method used in this research is the quantitative descriptive method Four Tier Test. This research involved 80 class VII junior high school students in Padang Barat District. The results of the research are students' misunderstanding of the concepts of temperature, heat and expansion in Padang Barat District Middle School (68%) which is relatively high. Based on data analysis, it is known that students have the highest misconception regarding the concept of explaining temperature (81%).

**Keywords:** Four tier test; Heat and expansion; Misconception; Temperature

## Introduction

Education is a communication activity regarding insight to increase knowledge (Yahya, 2014). Education is needed so that humans can develop all the potential within themselves according to their good and perfect innate gifts (Rahmat, 2013). Effective education has good learning materials (Kristanto, 2016). Learning materials contain information in the form of facts, principles and concepts needed for successful learning (Makki & Aflahah, 2019). In education there is a process of learning activities (Pratiwi et al., 2019). The concept of good and effective learning in learning must be implemented (Kusuma et al., 2019).

The learning concept is a system in learning design that is applied in learning to achieve maximum results (Hanafy, 2015). Concepts are knowledge in adapting (Huda et al., 2024). Concept is knowledge expressed through words after observing an object (Saputri, 2021).

Students develop the potential that exists within them due to a deep understanding of the concepts of the material they have studied (Siahaan et al., 2023). It is important for students to understand learning concepts (Kim, 2021).

Understanding concepts is a discussion in learning activities to be applied and facing problems that occur at school (Ariani et al., 2020). Scientific concepts can be analyzed and defined through completeness, precision, consistency and circularity (Wong et al., 2020). Understanding concepts and applying them in solving problems must be considered (Rahmadani et al., 2023). If students cannot interpret knowledge from experiences and learning concepts learned, it can give rise to misconceptions (Kamila, 2018). In increasing students' understanding, educators use appropriate learning models (Arif, 2020). Understanding learning concepts is the focus or thing that must be paid attention to in the

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learning process so as not to give rise to misconceptions (Ariani et al., 2020).

Misconceptions are misunderstandings in interpreting the meaning of knowledge (Ojose, 2015). The difference between students' conceptual ideas and scientific concepts is called misconception (Resbiantoro & Setiani, 2022). Misconceptions are ideas that are contrary to actual material (Batlolona & Jamaludin, 2024). Thus, students' misconceptions can be seen as inaccurate conceptual understanding that is structured, systematic and leads students to consistent and explicit errors (Udil & Amsikan, 2020). Misunderstandings are caused by students' preconceptions (Afriwardani et al., 2023). Other causes include associative thinking, humanistic thinking, incomplete reasoning and wrong intuition (Kurniawati & Ermawati, 2020). In learning, educators should be creative with learning innovations so that learning is appropriate and students understand learning better (Rezeki et al., 2021). Educators must have professional competence because it is the most important part of conceptual understanding to avoid misconceptions (Hasnawati et al., 2022). Misconceptions often occur in science learning (Suparno, 2013).

Science learning is concrete and abstract learning material so that the learning process requires seeking knowledge scientifically (Fax et al., 2018). Critical thinking is a science learning competency that causes high learning mastery so that learning objectives are achieved (Marisda et al., 2024). The aim of learning science concepts is to be able to explain the concepts that have been studied, to be able to differentiate one concept from another, to be able to connect between concepts and apply the concepts in everyday life (Faizah, 2016). In minimizing misconceptions, teachers should provide appropriate learning methods and provide evaluation questions to measure students' understanding of concepts (Lestari & Widaningtyas, 2020). To find out further actions regarding concepts that are understood, students can use diagnostic tests (Orcid, 2022).

Diagnostic tests are tests that are applied to determine the weaknesses faced by students in a lesson (Rahman & Nasryah, 2019). When preparing a diagnostic test, you must pay attention to the aspects to be measured, the composition, objectives, validity, answer key, scoring and interpretation (Ropii & Fahrurrozi, 2017). Diagnostic tests can be carried out by educators to measure students' level of understanding after learning (Jamaludin et al., 2022). A good diagnostic test can show how many concepts students have mastered, determine the difference between concepts that students understand and those that still need to be learned and can determine inconsistencies in students' way of thinking (Suwanto, 2013).

Students' misconceptions can be identified through various instruments (Gurel et al., 2015). Educators need

to reduce misconceptions so that students' learning processes run well (Utari & Ermawati, 2018). One form of diagnostic test that can be used is a multiplechoice test with the Four Tier Test instrument (Saputri, 2021). In accordance with the opinion of Putri et al. (2020) that misconceptions can be identified specifically and accurately by combining CRI techniques with other tests.

The Four Tier Test is a test that consists of four levels which constitute instrument development (Maison et al., 2021). The advantages of the Four Tier Test diagnostic test are that it carries out diagnostic tests for many misconceptions among students, differentiates the level of students' conceptual understanding more accurately, can emphasize parts of the material that need to be emphasized and can immediately plan learning regarding students' misconceptions (Sukarelawan et al., 2021). The Four Tier Test has advantages over other forms of tests, namely, it can find out more deeply the misconceptions experienced by students in a shorter time (Areni et al., 2018). However, the Four Tier Test diagnostic test is rarely carried out because it takes quite a long time to make the instrument (Abbas, 2020). With the Four Tier Test, students can be seen who really understand the concept, lacking knowledge and misconceptions (Gurel et al., 2015).

Misconceptions often occur in science learning such as physics regarding temperature, heat and expansion (Suparno, 2013). Misconceptions in science learning are often difficult to understand correctly and give rise to misinterpretations (Hunaidah et al., 2022). Research conducted by Lolika (2021) at SMPN 2 Jambi using the Four Tier Test instrument, students experienced misconceptions. So researchers will identify misconceptions regarding temperature, heat and expansion material in West Padang sub-district, especially schools that are accredited A. The better the school's accreditation, the better the students have the ability to think critically so that students' mastery of concepts is high (Marisda et al., 2024). This research aims to determine the profile and percentage of students' misconceptions so that these misconceptions can be corrected and educators can generalize learning concepts in various contexts.

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**Method**

This research uses quantitative descriptive methods. The research sample for A-accredited junior high schools in Padang Barat sub-district used a proportional sampling technique with the Slovin formula so that the sample consisted of 80 students at SMP N 2 Padang and SMP N 3 Padang. The selected research sample will be a basic benchmark for students who experience misconceptions in answering the questions that have been prepared.

This stage of research consists of four steps. In the first stage, the researcher carried out a preliminary study in the form of a literature study and observation of the sample's convenience. In the second stage, the researcher made preparations in the form of compiling the

instruments that would be used in the research. The third stage is the implementation stage, this stage the researcher carries out the research by testing the instruments that have been prepared. The fourth stage is the completion stage, the researcher will process the research data which will be included in the research results. The instrument used is a Four Tier Test diagnostic instrument in data collection techniques.

The Four Tier Test instrument consists of four levels of questions, namely, the first level is knowledge questions, the second level is beliefs from the first level, the third level is the reasons for knowledge answers and the fourth level is beliefs from the reasons for knowledge answers (Gurel et al., 2015). The instrument that has been validated in this research contains 20 questions that will be used in the research. The questions in this research are instruments from Lolika Saputri and Evi Septiyani which were then developed by researchers.

The data collection technique is analyzing research data by grouping answers from students who understand the concept (Scientific Conception), lack of knowledge (Lack of Knowledge), false positives (False Positive), false negatives (False Negative) and misunderstanding of the concept (Misconception). The classification of students' conceptual misunderstandings consists of misconceptions, false positives and negatives, as in the following table.

**Table 1.** Concept understanding category in the Four Tier Test (Gurel et al., 2015)

Stage	Category			
I	II	III	IV	
Correct	Certain	Correct	Certain	SC
Correct	Certain	Correct	Not sure	LK
Correct	Not sure	Correct	Certain	LK
Correct	Not sure	Correct	Not sure	LK
Correct	Certain	Wrong	Certain	FP
Correct	Certain	Wrong	Not sure	LK
Correct	Not sure	Wrong	Certain	LK
Correct	Not sure	Wrong	Not sure	LK
Wrong	Certain	Correct	Certain	FN
Wrong	Certain	Correct	Not sure	LK
Wrong	Not sure	Correct	Certain	LK
Wrong	Not sure	Correct	Not sure	LK
Wrong	Certain	Wrong	Certain	MSC
Wrong	Certain	Wrong	Not sure	LK
Wrong	Not sure	Wrong	Certain	LK
Wrong	Not sure	Wrong	Not sure	LK

The percentage of students' knowledge is grouped using the formula:

$$P = \frac{f}{N} \times 100\% \tag{1}$$

Information:

P = Percentage

f = Number of students for each question  
 N = Number of samples

Then the results of the percentage of student misconceptions will be classified into the following categories.

**Table 2.** Misconceptions Percentage Category (Maison et al., 2021)

Percentage	Category
0-30%	Low
31%-60%	Currently
61%-100%	Tall

**Result and Discussion**

Understanding results draft participant educate after did it study use instrument Four Tier Test on the material temperature, heat and expansion can be expressed as percentages as following.

**Table 3.** Results of the Percentage of Students' Conceptual Knowledge

Draft	Question Number	Category (%)		
		FP	FN	MSC
Explain Draft Temperature	1	1	9	76
	2	34	13	38
Explain phenomenon temperature in life daily	3	12	1	39
	4	49	0	40
Apply measurement scale temperature with various type scale	5	8	4	18
	6	11	21	13
Describe draft heat	7	40	1	19
	8	36	4	39
Describe connection heat with change temperature	9	19	12	36
	10	17	8	53
Determining Miscellaneous displacement heat	11	43	11	14
	12	21	5	55
Differentiate displacement heat in a way convection, conduction and radiation	13	11	19	50
	14	5	42	9
Explain phenomenon heat in life daily	15	12	4	58
	16	12	21	56
Factor affecting heat expansion	17	1	6	55
	18	16	2	37
Length, area and volume resulting expansion	19	9	9	58
	20	8	9	15

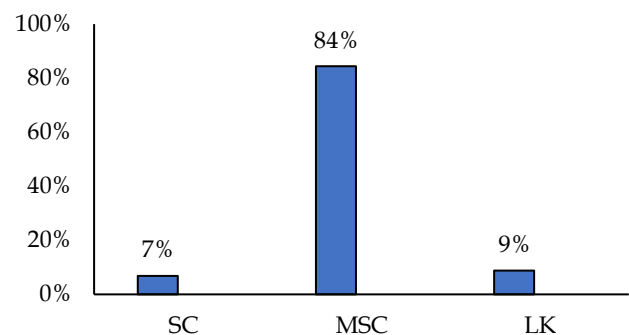
Then, from the results of the percentage of students' conceptual knowledge, the level of misconception can be categorized in the material on temperature, heat and expansion.

**Table 4.** Categories of Student Misconceptions

Draft	Percentage Misconceptions	Category Misconceptions
Explain Draft Temperature	84	Tall
Explain phenomenon temperature in life daily	56	Currently
Apply measurement scale temperature with various type scale	46	Currently
Describe draft heat	69	Tall
Describe connection heat with change temperature	68	Tall
Determining Miscellaneous displacement heat	78	Tall
Differentiate displacement heat in a way convection, conduction and radiation	72	Tall
Explain phenomenon heat in life daily	78	Tall
Factor affecting heat expansion	64	Tall
Explain coefficient expansion Length, area and volume	81	Tall
Describe characteristic expansion caused by temperature and heat	58	Currently

*Explaining the Concept of Temperature*


The percentage of misconceptions identified regarding the temperature concept was 84%, which is relatively high. Students who experience misconceptions assume that if the temperature of water is heated continuously, the temperature will rise to more than 100°C because the increase in temperature causes the water to run out. Students understand that the correct concept is that the temperature will remain 100°C when heated and the heat received by the water will not increase the temperature but will change the liquid state to steam. Based on Wagiran et al. (2023), if heat is given to an object, the temperature will reach a maximum temperature and then the object will change shape.



**Figure 1.** The percentage of misconceptions explains the concept of temperature



(1) Take note picture next!



Things happen if the water is already boiling heated continuously is ...

- temperature rises more from 100°C
- water temperature remains 100°C
- The water temperature changes
- water temperature is up and the pot become burnt

(2) Ananda is sure? with choice Ananda's answer!

- Certain
- Not sure

(3) Ananda's reason for choosing answer :

- The heat received by the water causes the temperature continues to rise until the water runs out.
- The heat received by the water will absorbed by air above the water
- The heat received by water is not for raise temperature but used for change exists substance liquid become a gas.
- The heat received by water for raise temperature thing .

(4) Are Ananda sure? to choice reason Ananda's answer!

- Certain
- Not sure

Figure 2. Question numbers 2 (Saputri, 2021)

Explain the Phenomenon of Temperature in Everyday Life

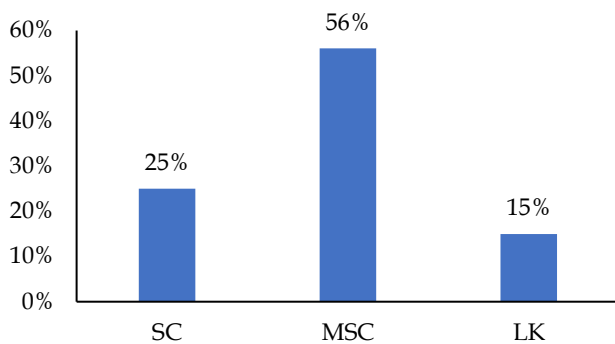



Figure 3. Percentage of misconceptions explaining temperature phenomena in everyday life

(1) Take note picture next!



When drying two identical clothes However the color different. One of colored black and the others are colored white, then what happens is ...

- Colored clothes black more fast dry
- Colored clothes white more fast dry
- Both clothes are dry simultaneously
- Both clothes are not will dry

(2) Are Ananda sure? with choice Ananda's answer!

- Certain
- Not sure

(3) Ananda's reason for choosing answer:

- Colored clothes black nature absorb light, so energy radiation received the more big
- Colored clothes black nature reflect light, so that the radiant energy is received the more small
- Colored clothes white nature absorb light but energy radiation received No Lots
- Colored clothes white nature reflect light, so energy radiation received the more big

(4) Are Ananda sure? to choice reason Ananda's answer!

- Certain
- Not sure

Figure 4. Question numbers 5 ( Saputri, 2021)

The percentage of misconceptions identified was 56% which was classified as moderate. Students who experience misconceptions think that white clothes dry faster because black clothes reflect light so that the radiation energy they receive is greater. The correct concept is that black clothes dry faster because black clothes reflect light so that the radiation energy received is greater (Paminto et al., 2021).

Applying Temperature Scale Measurements with Various Scales

The percentage of misconceptions identified was 46% which was classified as moderate. Students who experience misconceptions assume that the conversion of water temperature of 53°C is the same as 220K because converting temperature from Celsius to Kelvin is 273K - t°C. The correct concept is the temperature conversion of 53°C to 326K with the formula t°C + 273K (Prihandono, 2021).

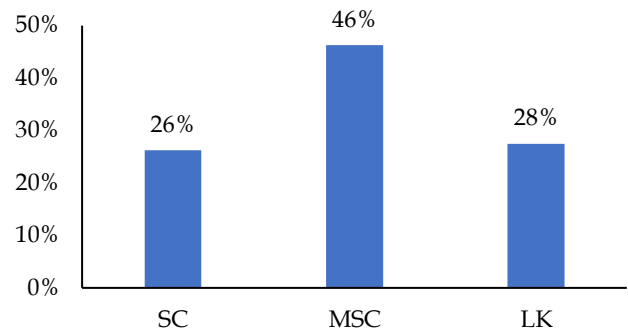


Figure 5. Percentage of misconceptions applying temperature scale measurements with various scales

(1) If increase water temperature on the scale thermometer Celsius is 53°C. Increase the temperature of water on a kelvin scale thermometer is ...

- 319 K
- 220 K
- 326 K
- 425 K

(2) Are Ananda sure? with choice Ananda's answer!

- Certain
- Not sure

(3) Ananda's reason for choosing answer:

- Due to look for temperature on the kelvin scale using formula t°C + 273 K
- Due to look for temperature on the kelvin scale using formula 273 K - t°C
- Due to look for temperature on the kelvin scale using formula t°C + 372 K
- Due to look for temperature on the kelvin scale using formula 372 K - t°C

(4) Are Ananda sure? to choice reason Ananda's answer!

- Certain
- Not sure

Figure 6. Question number 6 (Septiyani, 2019)

Describe the Concept of Heat

The percentage of misconceptions identified was 69%, which is relatively high. Students assume that the

characteristics of objects receiving/releasing heat are that the object's weight decreases due to high temperatures. The correct concept is based on Syahrattinnur et al. (2023) that objects that receive/release heat experience temperature changes caused by heat.

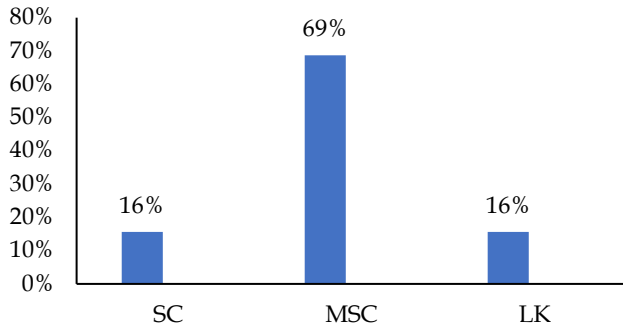


Figure 7. Percentage of misconceptions describing the concept of heat

- (1) Characteristics experienced something object moment accept/let go heat is ...
  - a. The weight reduce
  - b. There is change temperature
  - c. The mass increase
  - d. The volume still
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer:
  - a. Because heat = heat = temperature
  - b. Because objects have temperature more dominant (many) will change temperature other things
  - c. Heat is energy hot as can be influence temperature something object
  - d. Because if object release heat so the temperature will go up
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

Figure 8. Question number 8 (Septiyani, 2019)

*Describe the Relationship between Heat and Temperature Changes*

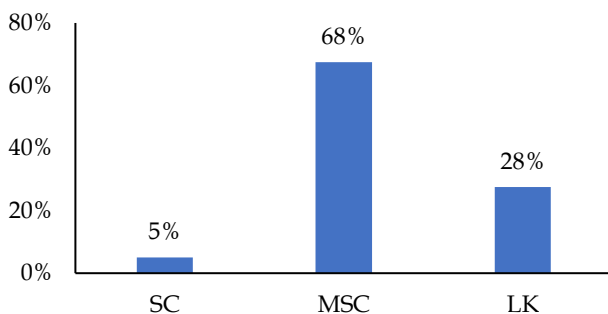


Figure 9. Percentage of misconceptions describing the relationship between heat and temperature changes

(1) There's fruit Objects A and B have masses The same. A temperature is more tall instead of B. second object touching. Will be happen transfer ....

- a. Temperature
- b. Heat
- c. Particle
- d. Mass

(2) Are Ananda sure? with choice Ananda's answer!

- a. Certain
- b. Not sure

(3) Ananda's reason for choosing answer:

- a. Temperature will falls and the temperature of B will rise so that temperature become balanced
- b. The temperature of A will rise and the temperature of B will down so that temperature become balanced
- c. Because of particles move consequence difference temperature
- d. Calories will flow instantly from the hot one to the cold one. Genre heat instantly This always in inclined direction equalize temperature

(4) Is Ananda sure to choice reason Ananda's answer!

- a. Certain
- b. Not sure

Figure 10. Question number 9 (Septiyani, 2019)

The percentage of misconceptions identified was 68%, which is relatively high. Students who experience misconceptions assume that when two objects are treated there will be a change in temperature because the temperature flows from a cold temperature to a hot temperature. Correct concept Based on Rohmah et al. (2019). if objects in contact have different temperatures, the heat flow tends to be in the same direction so that the temperature of the object is balanced from a higher temperature to a lower temperature.

*Determine the Various Types of Heat Transfer*

The percentage of misconceptions identified was 78%, which is relatively high. Students who experience misconceptions assume that the air in an air-conditioned room experiences radiation because the cool air radiates throughout the room. The correct concept is that the air in an air-conditioned room experiences convection because air that has a cool temperature moves to fill the room (Widodo et al., 2017).

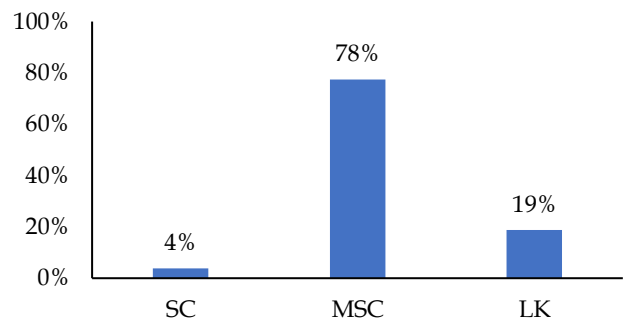


Figure 11. Percentage of misconceptions about determining various types of heat transfer

- (1) Air inside room can be air conditioned felt cool at each corner room although no exposed to AC direct. That matter happen Because heat in room spread in ...
  - a. Radiation
  - b. Conduction
  - c. Conductor
  - d. Convection
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer:
  - a. Because the air is cool scatter everything corner room
  - b. Because the air has temperature cool move fulfil room
  - c. Because the temperature is cool fulfil room without intermediary media
  - d. Because the temperature is cool need intermediary For fulfil room but No followed with displacement particle
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

Figure 12. Question number 10 (Septiyani, 2019)

*Distinguish between Heat Transfer by Convection, Conduction and Radiation*

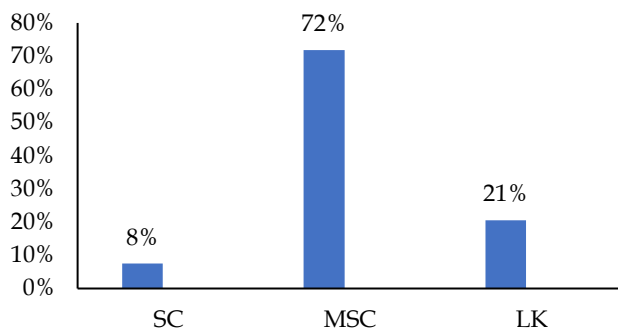


Figure 13. Percentage of misconceptions distinguishing heat transfer by convection, conduction and radiation

- (1) Incident happen wind sea, radiance ray the sun and the water cooking process uses kettle on fire, literally sequentially is a transfer process heat in ...
  - a. Convection, radiator and conduction
  - b. Convection, radiation and conduction
  - c. Radiation, convection and conduction
  - d. Radiation, convection and conductors
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer :
  - a. Incident wind sea , radiance ray the sun and the water cooking process uses kettle on fire is a transfer process heat
  - b. Incident wind sea heat move without substance intermediary and the process of cooking water using kettle on fire not a transfer process heat
  - c. Event the wind the sea calories moved along with the essence, on the beam ray Sun calories moved without substance medium and the process of cooking water using kettle on top fire displacement calories without substance intermediary
  - d. Incident wind sea, radiance ray the sun and the water cooking process above kettle is displacement heat without substance intermediary
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

Figure 14. Question number 11 (Septiyani, 2019)

The percentage of misconceptions identified was 72%, which is relatively high. Students who experience misconceptions assume that sea breeze events are an example of convection, sunlight rays are an example of a radiator and the process of cooking water in a kettle is an example of conduction. The correct concept is that the occurrence of sea breeze is an example of convection, that is, heat is transferred along with the substance, while heat transfer without intermediary substances occurs in the event of sunlight shining and boiling water in a kettle (Lusiani et al., 2020).

*Explain the Phenomenon of Heat in Everyday Life*

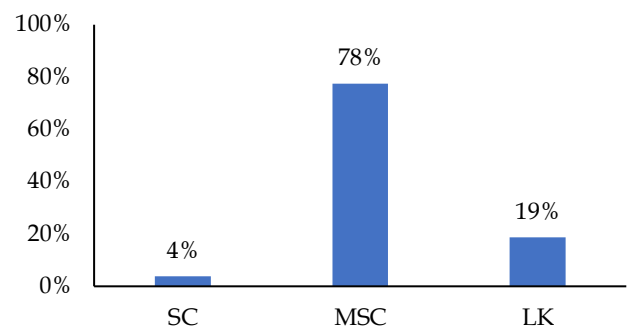


Figure 15. Percentage of misconceptions explaining heat phenomena in everyday life

- (1) On a night (20th) sky bright without clouds and night next (21st) sky cloudy so ...
  - a. Temperature air the 20th or so tall from temperature air date 21
  - b. Temperature air the 20th or so low from temperature air date 21
  - c. Temperature air the 20th is the same with temperature air date 21
  - d. Temperature air the 20th no The same with temperature air date 21
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer :
  - a. Clouds reflect radiation back to the surface earth
  - b. Clouds absorb reflected radiation earth
  - c. When the sky bright at night day temperature will more tall
  - d. When the sky dark and bright so the temperature will The same
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

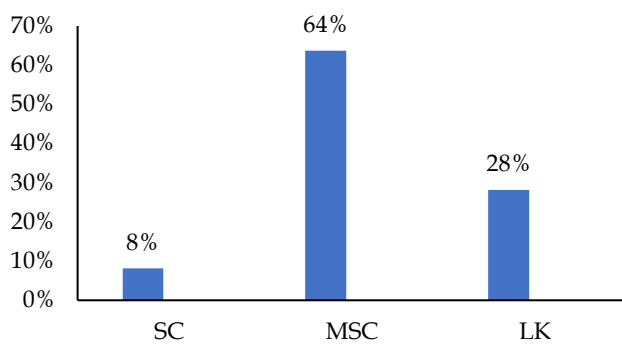
Figure 16. Question 13 (Saputri, 2021)

The percentage of misconceptions identified was 78%, which is relatively high. Students who experience misconceptions assume that the air temperature in a clear sky without clouds is higher than in cloudy skies because the clouds absorb radiation reflected by the

earth. The correct concept is that the air temperature in a clear sky without clouds is lower than in a cloudy sky because the clouds reflect the earth's radiation back (Ode Risnawati et al., 2022).

*Factors that Influence Heat*

The percentage of misconceptions identified was 64%, which is relatively high. Students assume that the specific heat of objects X and Y is the same because what influences the increase in temperature of the object is heat. The correct concept is based on Ode Risnawati et al. (2022) specific heat affects the increase in temperature of an object, the greater the specific heat the more heat is needed to increase the temperature, so that object Y heats up longer than object X.



**Figure 17.** Percentage of misconceptions about factors that influence heat

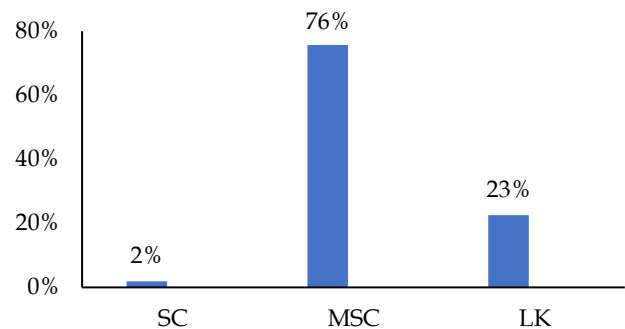
- (1) There are two objects X and Y whose masses The same . If second object heated with same source and same time, apparently thing X more fast hot from object Y. Which object has heat type more big ...
  - a. Object X
  - b. Thing Y
  - c. Objects X and Y are the same
  - d. Object X is hot the type more big from Y
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer:
  - a. Specific heat influence increase temperature object. The more big heat the type the more big heat required For raise the temperature .
  - b. Specific heat more small so will accept heat more Lots
  - c. Specific heat no influence increase temperature that thing influence increase temperature is heat
  - d. Specific heat the more big so required temperature will the more low because heat required the more big
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

**Figure 18.** Question number 14 (Septiyani, 2019)

*Explain the Coefficient of Expansion for Length, Area and Volume*

The percentage of misconceptions identified was 76%, which is relatively high. Students who experience misconceptions assume that when metal is heated it will

melt and a small portion evaporates on the grounds that a metal bar will melt when heated. The correct concept is that heated metal will experience a change in length because a metal bar will expand when heated (Widodo et al., 2017).



**Figure 19.** Percentage of misconceptions explaining the expansion coefficient of length, area and volume

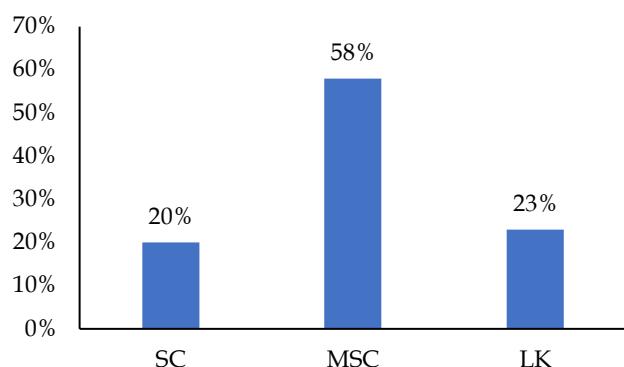
- (1) Thatched house zinc during the day day caught ray sun. Then the sheet zinc will undergoing a process of expansion ...
  - a. Long
  - b. Volume
  - c. Room
  - d. Wide
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer :
  - a. If objects congested shaped field heated so object the will experience Long expansion
  - b. If objects congested shaped field heated so object the will experience expansion room
  - c. If objects congested shaped field heated so object the will experience volume expansion
  - d. If objects congested shaped field heated so object the will experience expansion wide
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

**Figure 20.** Question number 17 (Septiyani, 2019)

*Describe the Nature of Expansion Caused by Temperature and Heat*

The percentage of misconceptions identified was 58% which was classified as moderate. Students who experience misconceptions think that the action taken to prevent the train tracks from bending due to heat is to lock them tightly at each railroad track intermediary because when the weather is hot the train tracks do not change. The correct concept is based on (Dewantara et al., 2022). The metal installed on railway tracks has a fairly large coefficient of linear expansion. When the temperature increases. The particles in the metal have enough energy and the metal changes size (expansion). By having a gap in the rail installation, the metal will have enough space when it expands.





**Figure 21.** Percentage of misconceptions describing the nature of expansion caused by temperature and heat

- (1) In 2020 temperature extreme in Jakarta makes rail train fire become bent. Rail train fire reach temperature 20°C more hot from temperature felt air. Necessary action done for avoid happen bending in the rail train fire is ...
  - a. Give gap between metal with distance certain
  - b. Close up metal on each rail train fire
  - c. Lock with tight each intermediary rail train fire
  - d. Close road train fire moment weather hot
- (2) Are Ananda sure? with choice Ananda's answer!
  - a. Certain
  - b. Not sure
- (3) Ananda's reason for choosing answer :
  - a. When the weather hot rail train fire own room for expansion
  - b. When the weather hot rail train fire no experience change
  - c. When the weather hot rail train fire will free
  - d. When the weather hot rail train fire will melt
- (4) Are Ananda sure? to choice reason Ananda's answer!
  - a. Certain
  - b. Not sure

**Figure 22.** Question number 20 (Septiyani, 2019)

## Conclusion

From the discussion it can be concluded that the percentage of students who experience misconceptions about temperature, heat and expansion is 68%, which is relatively high. The concept indicator explains the concept of temperature, namely 84% which is included in the high category and the lowest indicator is found in the concept and applies temperature scale measurements with various scales, namely 46% which is classified as medium.

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## Author Contributions

The research team contributed to writing this scientific work, K.A., as project administration, S.M., as writing the review,

A.N.P., and R.O., as validators, and N., and R.A., as research observers.

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## Conflicts of Interest

Research state no there is conflict in study this.

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