Identification of student misconceptions using a four-tier diagnostic test of light matter in Junior High School

by SULE-IJ SULE-IJ

Submission date: 25-Mar-2025 09:28AM (UTC+0700)
Submission ID: 2418923982
File name: 1._Sudirman_dkk.docx (308.88K)
Word count: 5867
Character count: 30993

Sriwijaya University Learning and Education – International Journal
e-ISSN: 3063-7856 p-ISSN: 3063-6701
Volume 1 Issues 2, November 2024: 73-87
SULE-IJ
Research Article

Identification of student misconceptions using a four-tier diagnostic test of light matter in Junior High School

Sudirman[1]*, Hamdi Aksan[1], Reva Akbarina Irpan[1]

[1]Physics Education Study Program, Faculty of Teacher Training and Education, Sriwijaya University
*Corresponding author, email: sudirman@fkip.unsri.ac.id

ABSTRACT
A study has been conducted to determine the level of misconception of the concept of light that occurs in grade IX students in junior high schools. This study used a descriptive quantitative method. The research data were obtained from the Four-Tier Diagnostic Test instrument. The instrument was in the form of multiple-choice questions with 4 options totalling 15 questions on the concept of reflection and refraction of light. The subjects of the study were students who had studied light material totalling 58 people. The variables in this study were how the misconceptions experienced by junior high school students on the reflection and refraction of light. This is an independent variable, while the results of the study on misconceptions are dependent variables. From the research that has been conducted, it was obtained that 68.39% of students still experienced many misconceptions, 15.40% students did not understand the concept, and 16.21% understood the concept. So that the average percentage of students who experienced misconceptions overall was in the high category. The highest percentage of misconceptions regarding the concept of light propagation with a percentage of 31.03%. Students experience moderate misconceptions in the moderate category with a percentage of 15.60%.

ARTICLE HISTORY
Received 1 November 2024
Revision 28 November 2024
Accepted 30 November 2024
KEYWORDS
Misconception; light instrument; four-tier diagnostic test.

http://doi.org/10.55379/sule-ij.v1i2.6

Introduction

Natural Sciences is one of the subjects in school. Sudirman et al. (2020) Physics is one of the branches of natural science that studies matter and energy and their interactions. However, this subject is rarely well understood by students (Araujo et al., 2008). Natural Sciences is one branch of science that discusses, describes, analyses, and applies natural phenomena such as motion, heat, waves, electricity, magnetism, and attraction (Sariyah et al., 2022). There is a lot of knowledge that will be understood from studying physics, including basic knowledge about natural phenomena learned in natural sciences subjects. then an answer will be obtained from an event, phenomenon or a problem. Physics is one of the IPA subjects studied by students at the Junior High School level.

Conceptual understanding is also one of the main things in science learning, especially physics, chemistry, and biology, so that students do not need to memorize formulas but understand concepts (Capriconia & Mufit, 2022). An absolute requirement for successful science learning is understanding a concept (Febrianti et al., 2019). Low understanding of science concepts will have an impact on students and lead to low student learning outcomes (Yulisa et al., 2020). Physics learning requires more understanding and reasoning than memorization (Hau & Nuri, 2019). Increasing

understanding of physics concepts needs to be pursued for the success of students in learning. Students must be able to understand concepts well to apply their knowledge in everyday life (Gunawan et al., 2018). This is evidenced by several studies on light material, such as research conducted by Rochim et al., obtained results that there are still many students who experience misconceptions about light material at SMPN 1 Ngadiluwih and SMPN 7 Kediri with percentages of 38% and 31% respectively (Rochim et al., 2019). Another study conducted by Hidayati et al. (2016) identified misconceptions experienced by class X students at SMAN 1 Indralaya on the concept of elasticity and Hooke's law, namely 51.05% experiencing misconceptions.

Identification is the desire to search for, find, collect, explore, or investigate a problem by utilizing the information that has been collected (Ananda & Syuhendri, 2023). Based on the opinion above, it can be concluded that identification is the process of recognizing or investigating something based on the information that has been obtained. Misconceptions are one of the obstacles to student learning (Caballes et al., 2020). Misconceptions are errors in understanding or obtaining a wrong understanding of a concept, principle, or fact (Royani & Setyarsih, 2022). Misconceptions are difficult to change and inhibit the absorption of further material (Wulandari et al., 2022) so misconceptions can cause problems in communication and affect the expected results, especially in the fields of science, technology, and education.

Light is an electromagnetic wave that can propagate without requiring a medium as an intermediary. Kent & Kinney (2021) light is an electromagnetic wave that can be seen with the eye. Light can be concluded as one of the electromagnetic waves that can be seen with the eye and does not require a medium as an intermediary. Light is a transverse electromagnetic wave whose wavelength is in the range of 400 nm - 600 nm. Light propagates in a straight line. Light can penetrate clear objects, can be reflected, can be refracted if it passes through two mediums with different refractive indices, has energy, can be waves or particles, can propagate without a medium.

Diagnostic tests are tests that aim to detect concepts, misconceptions, and not understanding concepts (Ilza et al., 2021). Hadi et al. (2015) diagnostic tests are evaluation tools that can be used to find and accurately determine the weaknesses and strengths of students in a particular subject. Based on these two opinions, it can be concluded that diagnostic tests are tests to quickly test a person's understanding of whether they have misconceptions or understand concepts or do not understand concepts about a topic. Shim et al. (2017) diagnostic tests in education are initial assessments used to detect students' abilities in learning. Fariyani et al. (2015) diagnostic tests are divided into 4 levels, including questions with one correct answer and three incorrect answers, the level of confidence in the answer, reasons, and the level of confidence in the reasons. The level 4 diagnostic test is a refinement of the previous level diagnostic test, to reduce the shortcomings in the previous level test. The 4-level diagnostic test is more valid in determining conceptions and misconceptions compared to one-level tests or two-level tests, and three-level tests.

Sudirman et al. (2023) the 4-level diagnostic test is a tiered test used to identify misconceptions. Fadiyani et al. (2015) the advantages of the 4-level diagnostic test include separating the level of confidence in the answer and the level of confidence in the reasons chosen, detecting deep misconceptions experienced, material that requires more emphasis to be determined, and effective learning design.

Method

This study uses a descriptive and quantitative method approach. The purpose of solving this problem is to find existing solutions and in accordance with research procedures, identifying misconceptions using the Four-Tier Diagnostic figure 1 below:

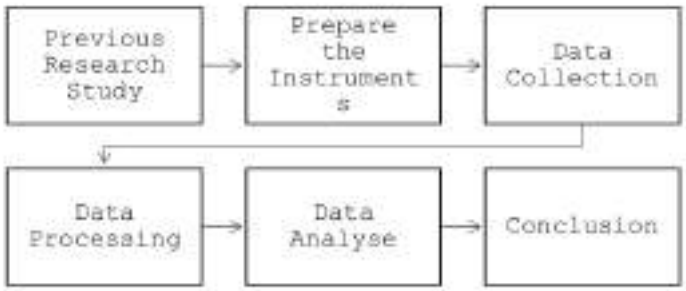

Figure 1. Research Flow

The data obtained were in the form of a percentage of junior high school students' misconceptions about the material on light, namely: (1) explaining the properties of light; (2) explaining the propagation of light; (3) explaining the refraction of light; and (4) explaining light as an electromagnetic wave (radiation).

The research instrument used was a 4-level diagnostic test previously created by (Nurmawati, 2022). The development of the test increased the level of student confidence in choosing test reasons in the form of a pair of valid questions totalling 15 questions. The 4-level test format instrument is one of the instruments used to diagnose the level of student conception of a science concept (physics, chemistry, and biology) (Rawh et al., 2020).

Table 1. Instrument Grid for Misunderstanding of the Concept of Light (Nurmawati, 2022)

Basic competencies	Indicator	Number of questions	Question Number
Analyzing the properties of light and shadow formation on	Explain the properties of light	5	1, 2, 3, 4, 5
	Explain the propagation of light	4	6, 7, 8, 9
	Explain about reflection and refraction of light	3	10, 11, 12

flat and curved surfaces	Describe light as an electromagnetic wave	3	13, 14, 15

The data analysis technique in this study uses descriptive analysis.

Table 2. Interpretation of 4-Level Diagnostic Test Results (Fariyani et al., 2015)

Answer	Confidence in the answer	Reason	Belief in reason	Criteria
Correct	Tall	Correct	Tall	Understanding the Concept
Correct	Low	Correct	Low	Not Understanding the Concept
Correct	Tall	Correct	Low	
Correct	Low	Correct	Tall	
Correct	Low	False	Low	
False	Low	True	Low	
Fake	Low	Fake	Low	
True	High	Fake	Low	
Fake	Low	True	High	
True	Low	Fake	High	Misunderstanding
True	High	Fake	High	
Fake	High	True	Low	
Fake	High	True	High	
False	Tall	False	Low	
False	Low	False	Tall	
False	Tall	False	Tall	

Analysis of the level of misconception to obtain the level of misconception using the misconception percentage calculation formula.

Table 3. Classification of students' misconception levels

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

Results and Discussion

This study was obtained from written test data using a 4-level diagnostic test instrument to identify students' misconceptions about light material developed from a three-level diagnostic instrument to identify misconceptions. The instrument used was a multiple-choice test consisting of 15 questions with answer choices and reasons. The answer data along with the reasons that have been obtained are then grouped into three criteria for understanding the concept of light material using a 4-level diagnostic test instrument. The three criteria consist of understanding the concept, not understanding the concept, and misconceptions. Data analysis is carried out by finding the average percentage of understanding the concept based on the criteria for understanding the concept and finding the grouping of the level of misconception in each question item experienced by students based on the grouping of the level of

misconception. The classification of the level of misconception is divided into 3 categories, namely high, medium, and low categories. The categories of understanding the concept, not understanding the concept, and misconception after analysis can be seen in table 4.

Table 4. Number of students based on conceptual understanding

Question Number	Understanding the concept	Number of students				
		Percentage	Don't understand the concept	Percentage	Misunderstanding	Percentage
1	29	50%	5	8.62%	24	41.38%
2	31	53.45%	11	18.96%	16	27.59%
3	4	6.9%	5	8.62%	49	84.48%
4	0	0%	7	12.07%	51	87.93%
5	9	15.5 2%	7	12,07%	42	72.41%
6	30	51.72%	4	6.9%	24	41.38%
7	2	3,45%	14	24.14%	42	72.41%
8	9	15,52%	10	17,24%	39	67.24%
9	10	17,24%	9	15,52%	39	67,24%
10	3	5.17%	9	15.52%	46	79.31%
11	2	3,45%	14	24,14%	42	72.41%
12	4	6.9%	11	18,96%	43	74,14%
13	3	5.17%	11	18,96%	44	75,87%
14	0	0%	9	15.52%	49	84.48%
15	5	8.62%	8	13.79%	45	77.59%
Average		**16.21%**		**15.40%**		**68.39%**

Table 4 shows students who experience high category misconceptions, namely in questions 3, 4, and 14, namely 84.48%, 87.93%, and 84.48%. Meanwhile, students who experience moderate category misconceptions are in questions 1, 2, and 6, namely 41.38%, 27.59%, and 41.48%. Students who understand the concept, who do not understand the concept, and who experience misconceptions can be shown through the following diagram:

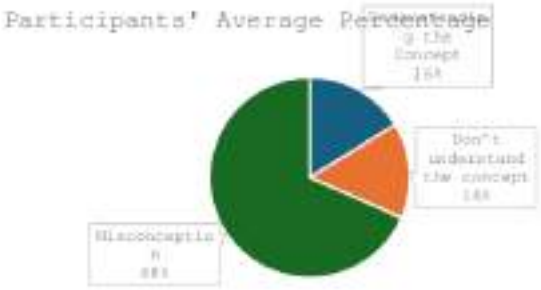

Figure 2. Diagram of average percentage of understanding

The highest percentage was in the misconception criteria at 68.39%, while the lowest percentage was in the criteria for not understanding the concept at 15.40%,

followed by the criteria for understanding the concept at 16.21%. The results of the data obtained show that the average percentage of grade IX students who experience misconceptions about light material is 68.39%. Based on the percentage data of misconceptions from 15 questions, each question can be categorized according to its level of misconception as shown in table 6 below:

Table 6. Misconception categories per question item

Indicator	Question Number	Frequency	Percentage of Misunderstanding	Misconception Category
Explain the properties of light	1	24	41.38%	Currently
	2	16	27.59%	Low
Explain the direction of light propagation	3	49	84.48%	Tall
	4	51	87.93%	Tall
	5	42	72.41%	Tall
	6	24	41.38%	Low
	7	42	72.41%	Tall
	8	39	67.24%	Tall
Explain about refraction	9	39	67.24%	Tall
	10	46	79.31%	Tall
	11	42	72.41%	Tall
Explain the properties of light as an electromagnetic wave	12	43	74.14%	Tall
	13	44	75.87%	Tall
	14	49	84.48%	Tall
	15	45	77.59%	Tall

Based on Table 6, it can be concluded that questions 2 and 6 are included in the low misconception category, question 1 is included in the moderate misconception category, while questions 3,4,5,7,8,9,10,11,12,13,14,15 are included in the high misconception category.

Each question is analysed for its answer choices and the reasons chosen based on the correct answers and reasons. Wrong answers and reasons can be categorized as misconception then the percentage of misconceptions is calculated. The results and discussion are in line with the results of research conducted by (Rochim et al., 2019) which aims to identify students' misconceptions about light materials at the junior high school level, finding that there are still students who have studied light materials but still experience misconceptions in the moderate category with a percentage of 35.60%. The forms of misconceptions that occur in junior high school students can be seen as follows:

Table 7. Forms of Student Misconceptions

No.	Identifying forms of misconceptions experienced by students	Percent
1	Rainbows occur because sunlight undergoes a straight propagation process, because sunlight travels straight into a room if it passes through a medium between	12.07 %

No.	Identifying forms of misconceptions experienced by students	Percent
	Rainbows occur because sunlight undergoes a process of reflection of sunlight through raindrops, which will be refracted and produce color, because rainbows can emit light after rain and produce spectral colors.	15.52 %
2	What happens in the image (image of a flashlight directed at a mirror) shows that light can be reflected, because light is polychromatic from several waves with different frequencies.	17.24 %
3	Being able to reflect is not a property of light, because light has a focal point.	5.17 %
	The ability to resist fire is not a property of light, because light can pass through transparent objects.	8.62 %
	The ability to resist fire is not a property of light, because light is a solid object.	5.17 %
	The ability to propagate in a straight line is not a property of light, because light has a focal point.	8.62 %
	Rotation is not a property of light, because light can pass through transparent objects.	13.79 %
	Rotation is not a property of light, because light has a focal point.	13.79 %
	Rotation is not a property of light, because light is a solid object.	13.79 %
4	Clear swimming pools often look shallower than they should be due to the presence of substances mixed in the pool water, because the substances mixed in the pool make the pool smell and will recede.	13.79 %
	Clear swimming pools often appear shallower than they should be due to the presence of substances mixed in the pool water, resulting from the bending of light rays as they travel from one medium to another medium of different density.	6.90 %
	Clear swimming pools often appear shallower than they should be due to the presence of substances mixed in the pool water, resulting from surface reflections scattered from various angles.	8.62 %
	Clear swimming pools often look shallower than they should be due to the perfect reflection, because the substances mixed in the pool make the pool smell and will recede.	5.17 %
	Clear swimming pools often appear shallower than they are due to perfect reflection, as light rays come from the refractive index of the medium.	22.41 %
	Clear swimming pools often appear shallower than they are due to refraction, as light rays come from different refractive indices of the medium.	6.90 %
	Clear swimming pools often appear shallower than they really are due to mixed reflections, due to scattered surface reflections from different angles.	12.07%
5	Requiring a propagation medium is one of the properties of light, because light can emit light and penetrate solid objects.	5.17 %

No.	Identifying forms of misconceptions experienced by students	Percent
	Requiring a propagation medium is one of the properties of light, because light can propagate through transparent objects.	6.90 %
	The ability to reverse direction is one of the properties of light, because light can emit light and penetrate solid objects.	8.62 %
	The ability to reverse direction is one of the properties of light, because light can propagate when passing through transparent objects.	6.90 %
	The ability to reverse direction is one of the properties of light, because light can reverse direction when directed at a dark object.	5.17 %
	Straight propagation is a property of light because light can emit light and penetrate solid objects.	5.17 %
	Traveling in a straight line is one of the properties of light because light can travel in a straight line if it passes through a transparent object.	12.07%
	Having space is one of the properties of light because light can propagate if it passes through a transparent object.	5.17 %
6	What happens in the image (image of a flashlight directed at clear glass) is that light can be refracted, because light is able to penetrate dark objects.	5.17 %
	What happens in the image (image of a flashlight directed at clear glass) is that light can be refracted, because light can be emitted.	5.17 %
	What happens in the image (image of a flashlight directed at clear glass) is that light can be refracted, because light has space.	5.17 %
	What happens in the image (image of a flashlight directed at clear glass) is that light can penetrate clear objects, because light can be emitted.	6.90 %
7	An object is placed 60 cm in front of a concave mirror that has a focal length of 180 cm. The image distance is 240 cm, because the image of the object can be seen based on the distance of the focal length to the distance of the object.	10.34%
	An object is placed 60 cm in front of a concave mirror that has a focal length of 180 cm. The distance of its image is 240 cm, because the image of the object cannot be seen based on the distance of the focal length from the object's position.	6.90 %
	An object is placed 60 cm in front of a concave mirror that has a focal length of 180 cm. The distance of its image is 240 cm, because the image of the object can be seen based on the distance of the object and the focal length of an object.	10.34 %
	An object is placed 60 cm in front of a concave mirror that has a focal length of 180 cm. The distance of its image is 120 cm, because the image of the object can be seen based on the distance of the focal length to the distance of the object.	3.45 %
	An object is placed 60 cm in front of a concave mirror that has	29.31 %

No.	Identifying forms of misconceptions experienced by students	Percent
	a focal length of 180 cm. The distance of its image is 120 cm, because the image of the object cannot be seen based on the distance of the focal length from the location of the object.	
	An object is placed 60 cm in front of a concave mirror that has a focal length of 180 cm. The distance of its image is 120 cm, because the image of the object can be seen based on the distance of the object and the focal length of the object.	5.17 %
	An object is placed 60 cm in front of a concave mirror that has a focal length of 180 cm. The distance of its image is -90 cm, because the image of the object cannot be seen based on the distance of the focal length from where the object is located.	5.17 %
8	The nature of light that appears in the image (the shadow of light coming from outside) is that light can be refracted, because the light is a ray that is refracted through a vacuum and will only experience refraction if it passes through the same medium.	10.34%
	The nature of light that appears in the image (the shadow of light coming from outside) is that light can be refracted, because it has the nature of light rays that are refracted through a vacuum and will only bend if they pass through the same medium.	5.17 %
	The nature of light that appears in the image (the shadow of light coming in from outside the room) is that light can be broken down, because it has a medium of shadow particles on objects through a vacuum.	6.90 %
	Light rays are refracted through a vacuum and will only rotate if they pass through the same medium.	
	The nature of light that appears in the image (the shadow of light coming in from outside the room) is that light can be reflected, because it has a medium of shadow particles on objects through a vacuum.	6.90 %
	The nature of light that appears in shadows (shadows of light entering from outside) is that light travels in a straight line, because it passes through the focal point of light on objects that have different densities.	17.24 %
9	Transparent objects are translucent, because transparent objects can block light.	31.03 %
	Transparent objects are translucent, because light that penetrates a transparent object will emit light.	12.07 %
	Dark objects are easily penetrated by light, while clear objects can block light.	5.17 %
	Dark objects are easily penetrated by light, because light can penetrate dark objects.	5.17 %
	Cloudy objects are easily penetrated by light, because light can penetrate dark objects.	5.17 %
10	If a pencil is put into a glass of water, the pencil will appear	6.90 %

No.	Identifying forms of misconceptions experienced by students	Percent
	broken and enlarged. This shows the nature of light, which is to propagate in a straight line, because when there is a change in light when passing through a medium with a different density, it will experience deflection.	
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light, which can penetrate transparent objects, because when light moves obliquely through a different medium, the object will experience deflection in the medium.	6.90 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light, which can penetrate transparent objects, because when there is a change in light when passing through a medium with a different density, it will experience deflection.	18.97 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light, which can penetrate transparent objects.	6.90 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light that can be reflected, because when there is a change in light when passing through a medium with a different density, it will experience deflection.	6.90 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light, which can be reflected, because when light moves obliquely through a clear object, it will experience deflection.	5.17 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the refractory nature of light, because when light moves obliquely through a different medium, the object will experience bending in that medium.	8.62 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light, which can be refracted, because when light moves at an angle through a clear object, it will experience deflection.	5.17 %
	If a pencil is put into a glass of water, the pencil will appear broken and enlarged. This shows the nature of light, which can be refracted, because when light travels through a medium, it will experience reflection.	6.90 %
11	The event of a change or deflection of the direction of a light beam from one substance to another substance with a different density is called a refraction of light, because the light is reflected in the direction of its propagation when passing through the medium.	13.79 %
	The event of a change or deflection in the direction of a light beam from one substance to another substance with a different density is called refraction of light, because the unification of	6.90 %

No.	Identifying forms of misconceptions experienced by students	Percent
	light occurs when it passes through different light beams.	
	The event of a change or deflection in the direction of a light beam coming from one substance to another substance with a different density is called light reflection, because when it passes through a medium, light reflection occurs.	6.90 %
	Bb: The event of a change or deflection of the direction of a light beam from one substance to another substance with a different density is called light reflection, because there is a deflection in the direction of light propagation when it passes through two different mediums.	13.79 %
	The event of a change or deflection of a light beam from one substance to another substance with a different density is called light unification, because light unification occurs when it passes through different light beams.	12.07 date 12.07 %
	Db: The event of changing or deflecting the direction of a light beam from one substance to another substance with a different density is called light propagation, because there is a deflection in the direction of light propagation when it passes through two different mediums.	5.17%
	The event of changing or deflecting the direction of a light beam from one substance to another substance with a different density is called light propagation, because light propagation occurs when the light beam experiences deflection.	10.34 %
12	The nature of the image produced by a concave mirror is virtual, upright, and reduced, because a concave mirror has an inverted image on its mirror.	13.79 %
	The nature of the image produced by a concave mirror is virtual, inverted, and reduced, because a concave mirror has an inverted image on its mirror.	5.17 %
	The nature of the image produced by a concave mirror is virtual, inverted, and reduced, because the mirror is concave with the focal point behind the mirror.	12.07 date 12.07 %
	The nature of the image produced by a concave mirror is virtual, inverted, and reduced, because a concave mirror is curved with a focal point in front of the mirror.	5.17 %
	The nature of the image produced by a concave mirror is real, upright, and enlarged, because the concave mirror is elongated with different focal points.	15.52 %
13	One of the properties of light is that it can propagate in a vacuum. This is because light is a transverse wave, a wave that can propagate vertically on its path.	18.97 %
	One of the properties of light is that it can propagate in a vacuum. This is because light is a transverse wave, which is a wave that can propagate in a medium.	10.34 %
	One of the properties of light is that it can propagate in a vacuum. This is because light is a longitudinal wave, which is a	8.62 %

No.	Identifying forms of misconceptions experienced by students	Percent
	wave that can propagate in a medium. One of the properties of light is that it can propagate in a vacuum. This is because light is an electromagnetic wave that can propagate vertically on its path.	10.34 %
14	Visible light includes electromagnetic waves that have a wavelength between 200 nm and 600 nm, because visible light	12.07 %
	Visible light includes electromagnetic waves that have a wavelength between 200 nm and 600 nm, because light can be seen with the naked eye.	6.90 %
	Ac: Visible light is an electromagnetic wave that has a wavelength between 200 nm and 600 nm, because light can be observed using a telescope.	8.62 %
	Visible light is an electromagnetic wave that has a wavelength between 300 nm and 700 nm, because visible light	5.17 %
	Visible light includes electromagnetic waves that have a wavelength between 300 nm and 700 nm, because light can be seen with the naked eye.	17.24 %
	Visible light includes electromagnetic waves that have a wavelength between 400 nm and 700 nm, because light can be observed using a telescope.	8.62 %
15	The ability to travel in a vacuum is not a property of waves. electromagnetic, because waves require a propagation medium	10.34 %
	The ability to move in a vacuum is not a property of electromagnetic waves, because waves are electric fields consisting of particles.	5.17 %
	Being able to propagate in a vacuum is not a property of electromagnetic waves, because waves are charged electric fields.	10.34 %
	Being able to reflect and refract is not a property of electromagnetic waves, because waves require a propagation medium.	5.17 %
	The ability to be reflected and refracted is not a property of electromagnetic waves, because waves are electric fields composed of particles.	12.07 %
	Transverse waves are not a wave property electromagnetic, because waves require a propagation medium	5.17 %
	Transverse waves are not a property of electromagnetic waves, because waves are charged by electric fields.	5.17 %
	Transverse waves are not a wave property electromagnetic, because waves are electric fields that have no charge	3.45 %
	Consists of particles that do not have wave properties electromagnetic, because waves require a propagation medium	1.72 %
	Consisting of particles is not a property of electromagnetic waves, because waves are electric fields consisting of	6.90 %

No.	Identifying forms of misconceptions experienced by students	Percent
	particles.	
	Consisting of particles is not a property of electromagnetic waves, because waves are charged electric fields.	3.45 %

Based on table 7, it can be concluded that there are 164 variations of misconceptions identified. After Related to the profile of students' misconceptions about the concept of reflection and refraction of light, there are still many misconceptions. For this reason, an appropriate learning method or model is needed. So that by choosing a learning model that matches the concept, students will gain a better understanding. Primarily by conducting experiments, students can prove the correct concept in the material of light objectively. In addition, contextual learning is very helpful in gaining objective experience as well. Students who use environment-based learning media will find it easier to understand the concept. Based on the environment, the media is in the student's environment, easy to obtain, and inexpensive.

Conclusion

Grade IX junior high school students experience misconceptions on the concept of light with an average percentage of high misconceptions of 68.39%. Do not understand the concept 15.40% and understand the concept 16.21%. The percentage of students who experience misconceptions overall is in the high-level category. The highest percentage of misconceptions regarding the concept of light propagation with a percentage of 31.03% of students experiencing moderate category misconceptions. Based on the conclusion of the research results above, it is suggested that further research is needed to find the factors causing misconceptions experienced by students. To overcome misconceptions by finding the right models, methods, and media according to the concepts to be learned.

References

Ananda, L., & Syuhendri, S. (2023). *Misconceptions of prospective physics teacher students on the period of lunar phases*. 090013. https://doi.org/10.1063/5.0122687

Araujo, I. S., Veit, E. A., & Moreira, M. A. (2008). Physics students' performance using computational modelling activities to improve kinematics graphs interpretation. *Computers & Education*, *50*(4), 1128–1140. https://doi.org/10.1016/j.compedu.2006.11.004

Caballes, D. G., Micah, F., & Abenes, D. (2020). Misconceptions in Chemistry of High School Teachers and its Origin. *CiiT International Journal of Data Mining and Knowledge Engineering*, *12*(3), 48–54. https://www.researchgate.net/publication/345975932

Capriconia, J., & Mufit, F. (2022). Analysis of Concept Understanding and Students' Attitudes towards Learning Physics in Material of Straight Motion. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1453–1461. https://doi.org/10.29303/jppipa.v8i3.1381

Fariyani, Q., Rusilowati, A., & Sugianto. (2015). Pengembangan Four-tier Diagnostic Test untuk Mengungkap Miskonsepsi Fisika Siswa SMA Kelas X. *Journal of Innovative Science Education*, *4*. https://journal.unnes.ac.id/sju/jise/article/view/9903

Febrianti, J., Akhsan, H., & Muslim, M. (2019). Analisis Miskonsepsi Suhu Dan Kalor Pada Siswa Sma Negeri 3 Tanjung Raja. *Jurnal Inovasi Dan Pembelajaran Fisika*, *6*(1), 90–102. https://doi.org/10.36706/jipf.v6i1.7819

Gunawan, G., Nisrina, N., Y Suranti, N. M., Herayanti, L., & Rahmatiah, R. (2018). Virtual Laboratory to Improve Students' Conceptual Understanding in Physics Learning. *Journal of Physics: Conference Series*, *1108*, 012049. https://doi.org/10.1088/1742-6596/1108/1/012049

Hadi, S., Ismara, K. I., & Tanumihardja, E. (2015). Pengembangan Sistem Tes Diagnostik Kesulitan Belajar Kompetensi Dasar Kejuruan Siswa Smk. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *19*(2), 168–175. https://doi.org/10.21831/pep.v19i2.5577

Hau, R. R. H., & Nuri, N. (2019). Pemahaman Siswa terhadap Konsep Hukum I Newton. *Variabel*, *2*(2), 56. https://doi.org/10.26737/var.v2i2.1815

Hidayati, F. N., Akhsan, H., & Syuhendri,). (2016). Identifikasi Miskonsepsi Siswa Kelas X Pada Materi Elastisitas dan Hukum Hooke di SMA Negeri 1 Indralaya. *Jurnal Inovasi Dan Pembelajaran Fisika*, *3*(2), 1–9. http://ejournal.unsri.ac.id/index.php/jipf/article/view/3838

Izza, R. I., Nurhamidah, N., & Elvinawati, E. (2021). Analisis Miskonsepsi Siswa Menggunakan Tes Diagnostik Esai Berbantuan Cri (Certainty of Response Index) Pada Pokok Bahasan Asam Basa. *Alotrop*, *5*(1), 55–63. https://doi.org/10.33369/atp.v5i1.16487

Kent, D. E., & Kinney, B. M. (2021). The effect of high-intensity focused electromagnetic procedure on visceral adipose tissue: Retrospective assessment of computed tomography scans. *Journal of Cosmetic Dermatology*, *20*(3), 757–762. https://doi.org/10.1111/jocd.13952

Nurnawati, S. (2022). *Pengembangan Instrument Diagnostik Three Tier Untuk Mengidentifikasi Miskonsepsi Siswa Pada Konsep Cahaya* (Issue 8.5.2017) [IAIN Bengkulu]. www.aging-us.com

Rawh, P., Samsudin, A., & Nugraha, M. G. (2020). Pengembangan Four-Tier Diagnostic Test untuk Mengidentifikasi Profil Konsepsi Siswa pada Materi Alat-alat Optik. *WaPFi (Wahana Pendidikan Fisika)*, *5*(1), 84–89. https://doi.org/10.17509/wapfi.v5i1.22888

Rochim, F. N., Munawaroh, F., Wulandari, A. Y. R., & Ahied, M. (2019). Identifikasi Profil Miskonsepsi Siswa Pada Materi Cahaya Menggunakfan Metode Four Tier Test Dengan Certainty of Response Index (Cri). *Natural Science Education Research*, *2*(2), 140–149. https://doi.org/10.21107/nser.v2i2.6241

Royani, A., & Setyarsih, W. (2022). Development of Google Form-Based Five-Tier E-Diagnostic Test to Identify Conception Levels and Track Students' Misconceptions

on Thermodynamics Materials. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *10*(3), 450. https://doi.org/10.33394/j-ps.v10i3.5209

Sariyah, S., Kuswanto, H., Nurcahyo, H., Ilma, A. Z., & Hujatulatif, A. (2022). Hamster (Cricetinae) Motion Assisted by Video Tracker Application on Motion Materials in Junior High School. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 2593–2598. https://doi.org/10.29303/jppipa.v8i6.1583

Sudirman, S., Kistiono, K., Akhsan, H., & Ariska, M. (2020). Pengembangan Instrumen Penilaian Pengetahuan, Sikap Dan Keterampilan Ipa Berbasis Berpikir Kritis Pada Konsep Listrik Siswa Smp. *Jurnal Inovasi Dan Pembelajaran Fisika*, *7*(1), 28–40. https://doi.org/10.36706/jipf.v7i1.10903

Sudirman, S., Ningsih, N. J., Saparini, Ariska, M., Andriani, N., & Pasaribu, A. (2023). Machine translated by google identifikasi miskonsepsi mahasiswa pendidikan fisika universitas sriwijaya menggunakan tes diagnostik empat tingkat pada materi fluida statis machine translated by google. *Jurnal Pendidikan Matematika, Sains, Dan Komputer (JMSCEdu)*, *3*(3), 26–33. https://doi.org/10.20527/jmscedu.v3i1.8664

Shim, G. T. G., Shakawi, A. M. H. A., & Azizan, F. L. (2017). Relationship between Students' Diagnostic Assessment and Achievement in a Pre-University Mathematics Course. *Journal of Education and Learning*, *6*(4), 364. https://doi.org/10.5539/jel.v6n4p364

Wulandari, A. S., Permana, N. D., Susilawati, S., Syarif, M. I., & Ilhami, A. (2022). Development of Science E-Modules for Middle Schools Integrated with Al-Qur'an Verses with Virtual Simulation of Solar System Material. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *8*(2), 305–314. https://doi.org/10.21009/1.08212

Yulisa, Y., Hakim, L., & Lia, L. (2020). Pengaruh Video Pembelajaran Fisika Terhadap Pemahaman Konsep Siswa Smp. *Jurnal Luminous: Riset Ilmiah Pendidikan Fisika*, *1*(1), 37. https://doi.org/10.31851/luminous.v1i1.3445

Identification of student misconceptions using a four-tier diagnostic test of light matter in Junior High School

ORIGINALITY REPORT

10%	8%	7%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	jppipa.unram.ac.id Internet Source	4%
2	www.coursehero.com Internet Source	1%
3	S N Azizah, H Akhsan, M Muslim, M Ariska. "Analysis of college students misconceptions in astronomy using four-tier test", Journal of Physics: Conference Series, 2022 Publication	1%
4	Anibal Cotrina. "Toward Brain-Computer Interaction in Paralysis", Springer Science and Business Media LLC, 2017 Publication	1%
5	journal.stkipsingkawang.ac.id Internet Source	1%
6	James Stewart. "Optical Principles and Technology for Engineers", CRC Press, 2019 Publication	1%
7	Lenni Khotimah Harahap, Resi Pratiwi, Agus Muliaman. "Development of four-tier assessment to detect student misconceptions", AIP Publishing, 2022 Publication	1%

8	Rendy Priyasmika. "Analysis of Misconceptions on Material Solubility and Solubility Product (Ksp) Using a Four Tier Diagnostic Test Instrument", Tarbiyah : Jurnal Ilmiah Kependidikan, 2023 Publication	1 %

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		