International Journal of Education and Teaching Zone, Volume 1 (Issue 2): 08-10 (2022)
DOI: https://doi.org/10.57092/ijetz.v1i2.48

THE JOURNAL OF IJETZ
(International Journal of Education and Teaching Zone)
P-ISSN: 2963-7899 I E-ISSN: 2830-7925
jurnal.yayasannurulyakin.sch.id/index.php/ijetz

Resource Identification and Level of Understanding of Particle Dynamics Concepts

Akbar Kadir Masalesi[1]*
[1]SMAN 1 Tikep, Sulawesi Tenggara, Indonesia

Article History:
Received: August 12, 2022
Revised: September 28, 2022
Accepted: October 03, 2022
Published: October 17, 2022

Keywords:
Conceptual Understanding, Level of Understanding, Particle Dynamics, Resource Theory

***Correspondence Author:**
akbar.kadir26@gmail.com

Abstract: The need for a complete understanding of concepts to prevent imperfect understanding still needs to be prioritized. Many student difficulties are still due to misconceptions that have not been straightened out. Resource theory also reveals this, which explains the phenomenon of imperfect student understanding. This study aims to reveal the students' difficulties in understanding physics concepts on the topic of Newton's laws. The study was conducted on 82 students of class X by using 11 questions of choice of reasons, students' answer choices became quantitative, and the reasons for students' answers became sources of qualitative data. Quantitative data were analyzed using descriptive statistics. Meanwhile, the data was analyzed qualitatively using the Miles and Huberman analysis stages to see students' level of understanding and activated resources. The results showed that many students still experienced very low conceptual understanding, averaging 37.58. This is shown in the 11 questions. Only five questions can be answered correctly by more than 50% of students. At the same time, fewer than 30% of students can answer the six questions correctly. However, only 11.53% of students can answer correctly and are accompanied by reasons by scientific concepts. The reasons given in answering indicate the existence of misconceptions experienced by students, with a percentage of 14.52%. At the same time, the remaining 55.54% indicate that students are at the level of not knowing by showing students' answers without giving reasons.

INTRODUCTION

In studying Physics, understanding Fundamental concepts and principles is one of the requirements for success in learning Physics (Simanjuntak, 2012). It is also part of the basic understanding of concepts which are explained as the thoughts of a person or group of people stated in definitions, laws and theories (Hamdani et al., 2014). Understanding concepts is necessary in learning physics as it has also been emphasized that students often have different understandings of scientific concepts (Diani et al., 2018). The advantage in understanding fundamental concepts is that they can be used as one of the keys to success in studying physics without memorizing formulas (Mardiyah et al., 2017).

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One of the fundamental concepts of physics that we often encounter in everyday life is Newton's Law. Newton's laws are directly related to natural phenomena that exist in everyday life. One of them is about Particle Dynamics, which always happens around us. So that the material and its interactions, including Newton's laws, need to be mastered by students.

In contrast, the study results show that Newton's Law is a difficult topic for students to understand. The difficulties experienced by students in everyday life concerning the concept of Newton's law, including the first is the phenomenon of action-reaction force which is still considered to occur on the same object. The second is Newton's law is not related to motion, and the third is the result between the mass of the object and the acceleration that occurs. experienced by an object is a force. This is stated in the research (Novitasari, 2016).

Students' difficulties in understanding these fundamental concepts are not without being based on something but can occur due to differences between students' understanding of concepts and scientific concepts or what we usually call misconceptions. As explained by (Saglam-Arslan & Devecioglu, 2010) every teacher must understand the basic concepts of force and motion to provide learning and understand the correct concept. This finding shows that one of the factors causing the difficulty of mastering concepts in students is that the teachers sometimes do not master the basic concepts of particle dynamics material. As a result, students understanding of concepts can differ from actual scientific concepts. This is one of the causes of misconceptions that must be addressed immediately because misconceptions cause students to experience difficulties in learning physics (Diani et al., 2018).

Seeing various studies that mention understanding the basic concepts of students, there are still many that are not in accordance with basic scientific concepts; it does not mean that students do not understand the material presented by the teacher, but that understanding is still not perfect (Rivaldo et al., 2019). As a written parameter, it is necessary to carry out a needs-based analysis so that teachers can determine what factors influence the misconceptions that occur in students (Gercek & Ozcan, 2015).

Several cognitive theories in previous studies that were used to explain students' learning difficulties, including the identification of students' understanding of misconceptions, have also been carried out. One of them is resource theory (Mulyastuti & Taufiq, 2018; Rivaldo et al., 2019). Problem-solving failure experienced by students is not because students do not have the right knowledge but because students fail to activate knowledge relevant to the problem, as described in the perspective of resource theory (Hammer, 2000). Seeing the problems that often occur in students' environment, resource theory can be very important, especially in physics education, because it can provide a better understanding of the phenomenon of misconceptions (diSessa, 2018).

The researcher observes that there are many studies that discuss the theory of misconceptions, while research on the level of understanding and resource theory is still rarely found as a reference for analyzing students' conceptual understanding. Basically, students are not completely wrong in expressing the concepts they receive, but there are several concepts that have not been fully understood, which leads to imperfect and

incorrect understanding (Misconception) (Suparno, 2005). So that the level of understanding of students' concepts is considered important to be used as a research topic; given the data on the level of understanding of students' concepts, this can be used as a reference to determine a better learning method and, according to the needs of students. Thus the number of students with low levels of understanding can be increased in various ways, one of which is by updating learning methods according to the current needs of students.

Based on the problems above, the researchers will conduct research that aims to identify students' conceptual understanding in the field of physics on the topic of Particle Dynamics in terms of understanding levels and resource theory.

THEORETICAL SUPPORT

Difficulties in Newton's Law Concept

One of the core objectives of learning physics is that students understand the concepts of physics so that they can explain the interrelationships between concepts and apply physics concepts appropriately and accurately. But not a few of the students have an incorrect understanding of the concept. This was also stated in several previous studies regarding students' understanding of physics concepts.

One of the findings in the research conducted by several researcher (Rivaldo et al., 2019; M. R. A. Taqwa, 2017; M. R. A. Taqwa et al., 2022; M. R. A. Taqwa & Faizah, 2016; M. R. A. Taqwa & Pilendia, 2018) is that students have difficulty understanding Newton's law concepts about particle dynamics. If you look at the results of the research, it shows that students experience difficulties stemming from their lack of mastery of Newton's law material concepts about force and motion which include inertia, velocity, acceleration, friction, and gravity in Newton's I, II, and III laws. Several factors that became the basis of students' difficulties were also explained in the study; namely, students only understood the concepts of force and motion based on daily experience and were less involved in scientific practice activities. On the other side, difficulty in understanding force can be caused by difficulties in understanding previously related topics, for example in understanding the topic of acceleration (Saputri et al., 2019). So that students do not master the concept well.

Another study, Hau & Nuri (2019) mentions that many students, after studying physics, cannot understand even the simplest parts, and many concepts are misunderstood, so physics is considered a difficult, complicated, and difficult science. The conclusion obtained from this research refers to understanding the concept of Newton's first law and experiencing misconceptions in analyzing the relationship between mass, weight, and object motion.

Difficulties in physically interpreting Newton's first law that occurred in 104 high school students in class X based on research conducted by (Fadlli et al., 2019) were said to occur because students only memorized the sound of the law, but students did not understand how to describe the forces acting on them. An object also assumes that the mass of the object affects the magnitude of the action-reaction force. Thus, students fail

to understand the basic concepts, as evidenced by the difficulty in applying the action-reaction force between two objects in everyday life.

Failure to understand the concept does not only occur in Indonesia. Research conducted by (Panprueksa et al., 2012) conducted on 93 students in the province of Uthaithani in Thailand showed that the average understanding of students' concepts after the pre-test and post-test on the material acceleration, action-reaction, friction, buoyancy, and motion of objects only get a value of 30% of the total correct value. However, most questions have emphasized the main concepts of force and motion related to everyday life rather than arithmetic operations. This means that most students still do not understand the basic concepts of particle dynamics. Based on the analysis conducted (Panprueksa et al., 2012), many misconceptions are found as barriers for students to understanding related concepts at a more complex level.

Students' difficulties in understanding Newton's laws occur due to difficulties in understanding the basic concepts; this is reinforced by research conducted by (Juliartini et al., 2020). They mentioned that the difficulties in understanding concepts experienced by students were divided into four types, namely (1) difficulties in understanding facts, (2) difficulties in understanding concepts, (3) difficulties in operating and calculating processes, and (4) difficulties in understanding principles. The results of the overall percentage of these types show that, in general, the difficulty of understanding Newton's law concepts is in the highest category, with 67.5% difficulty. In addition, internal and external factors also cause students to have difficulty understanding physics concepts.

Another factor that makes it difficult for students to solve physics problems is the failure to analyze a situation. This is by research conducted by (Lestari et al., 2018). They conducted research on class X students by giving five indicator questions. The results of the research show that the indicator for understanding the picture is 92.50%, with the criteria generally having difficulty, the indicator for reading & writing symbols is 8.13%, with the criterion of a small part having difficulty, the indicator converting units is 16.25% with the criterion of a small part having difficulty. The difficulty of the indicator of understanding the concept is 80%, with the criteria generally having difficulty, and the indicator performing arithmetic operations is 79.38%, with the criteria generally having difficulty. From the results of the data analysis, it can be concluded that the type of difficulty that students mostly do is an indicator of understanding the picture, which is 90.50% with the criteria, in general, having difficulty.

Students learning difficulties in solving Newton's law theoretical physics problems on motion were also discussed (Hijriani & Hatibe, 2021). Based on the results of his research, it can be concluded that the ability to solve problems with learning difficulties in physics in Newton's Law of Motion is classified as a moderate category. Factors that affect the ability to solve problems with learning difficulties in physics are internal factors, including (1) lack of interest in physics lessons, (2) fatigue and lack of knowledge of students on Newton's Law of Motion, (3) students do not understand the problem well. So that they do not understand what the question is asking (4), they use formulas that are not appropriate, and they do not re-check the completion process and the answers again. While external factors include (1) family atmosphere, (2) how to

educate parents, (3) parental attention, (4) friends to hang out with, (5) social media, and (6) applied curriculum and facilities to support the teaching and learning process. At school.

Resource Theory

The theory of "Resource" is a view that can reveal the mindset of individuals in understanding a concept. "Resource" is intended as a source of knowledge that is believed to be true, and its use depends on the context in which the knowledge is applied (Wahyuni, 2021). The knowledge given to students is not necessarily accepted entirely because the knowledge gained is still in the form of pieces that need to be activated to become a complete concept (Hammer, 2000). Resources that students have activated can be seen from the analysis of answers to the questions given. Several related researchers also carry out research that uses cognitive theory (Mulyastuti & Taufiq, 2018; Rivaldo et al., 2019) so that the misconception phenomenon can be straightened out and makes students understand the original concept (diSessa, 2018).

Concept Understanding Level

Concept understanding is a person's ability to rephrase the knowledge he has acquired, both in spoken and written form, to people so that theother person understands what is being conveyed (Suraji et al., 2018).

The criteria for understanding the concept level used in this study are classified into five levels, namely Sound Understanding (SU), Partial Understanding (PU), Partial Understanding with Specific Misconception (PUMS), Specific Misconception (SM), and No Understanding (NU). The criteria for the five levels of concept understanding were adapted from (Nadhor & Taqwa, 2020), which can be seen in Table 1.

Table 1. Level of Concept Understanding and Student Response Criteria.

Concept Understanding Level	Student Response Criteria
Sound Understanding (SU)	Complete and correct concept explanation
Partial Understanding (PU)	Arguments are true, but not complete (not all correct concepts are mentioned).
Partial Understanding with Spesific Misconception (PUSM)	Some of the arguments are true, but some are misconceptions.
Spesific Misconception (SM)	All arguments do not fit the context of the problem.
No Understanding (NU)	Does not provide arguments.

METHOD

This research is descriptive research by combining quantitative and qualitative research. Data retrieval in this study was carried out by giving a reasoned multiple-choice test about the concept of particle dynamics through a survey method for testing questions to the tenth graders of SMAN 1 Tikep, West Muna Regency, Southeast Sulawesi.

The instrument used in this research is multiple choice questions based on particle dynamics taken from several sources such as literature studies and physics books. The number of questions used by the researcher was 11, with the indicators shown in Table 2.

Table 2. Indicators of test questions for students used in the analysis of conceptual understanding on the topic of Newton's Law

No	Indicator
1	Students are able to understand the graph of the dependence of the resultant acting on an object as a function of time
2	Students are able to determine the magnitude of the normal force on an object at a certain point
3	Students are able to determine tangential acceleration
4	Students are able to determine the magnitude of the normal force at a certain point
5	Students are able to describe the forces acting on objects
6	Students are able to calculate the resultant force on objects
7	Students are able to understand the concept of action-reaction force
8	Students are able to calculate the magnitude of the velocity of an object on a flat surface
9	Students are able to calculate the magnitude of the normal force
10	Students are able to calculate the magnitude of the tension in the rope on a pulley system
11	Students are able to calculate the tension in the rope on an inclined plane

The data used in this study are quantitative data and qualitative data. Quantitative data was obtained from the number of students' scores in choosing the correct answer; then the data was analyzed by calculating descriptive statistics in the form of a measure of data concentration with the average point, median, mode, and standard deviation of according to the concept understanding score in Table 3.

Table 3. Concept Understanding Score

Score	Category
80 – 100	Very High
70 – 79	High
50 – 69	Low
≤ 49	Very Low

(Anggereni & Khairurradzikin, 2016)

Qualitative data were obtained from the reasons students answered the questions. The reasons are then analyzed using the criteria of understanding level and based on resource theory with Miles and Huberman Analysis (Huberman & Miles, 1994), namely (1) data reduction, which includes activities to select, focus on, and achieve data, (2) data presentation describes the information provided. have been arranged sequentially and clearly, (3) data collected after the researcher conducted research to provide an explanation of the data presented (Yusuf, 2017).

RESULT AND DISCUSSION

Descriptive Statistical Data Understanding Newton's Law Concepts

Descriptive statistical data describes students' general ability to understand Newton's Law concepts. The research that has been done shows that the student's ability to understand Newton's Law concepts is still at an average of 37.58 and falls into the very low category. This value is obtained from the average score of students in answering all questions. This shows that most students still have low conceptual understanding when viewed from the students' correct answers, which are not by the basic rules on average. According to research conducted (Dimas, 2020) pemahaman konsep siswa sangat mempengaruhi , students' conceptual understanding greatly affects their continuation in studying other materials. In addition, the factor of intuition (feeling) also greatly affects the understanding of students' concepts. This is in line with research (Handhika et al., 2016) that intuition influences students' conceptual understanding. This makes students; when they cannot solve a problem, they will use their intuition as an alternative in answering it, even though the answer is sometimes out of the original rules. The descriptive statistical data on students' conceptual understanding is shown in Table 4.

Table 4. Descriptive Statistical Data Understanding the Concept of Particle Dynamics

Descriptive Statistics	Score
Average	37.58
Median	36.36
Mode	45.45
Standard Deviation	14.62

Meanwhile, the percentage of students who answered the questions correctly for each item is shown in Figure 1.

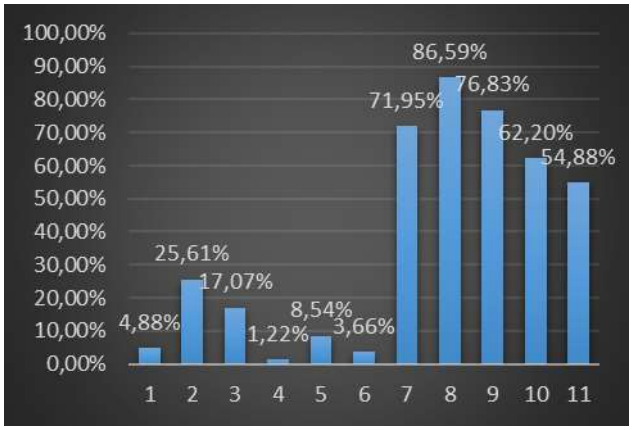


Figure 1. Percentage of Students Who Answered Each Question Correctly**.**

Based on Figure 1 above, it can be concluded that most students can solve questions properly and correctly on questions number 7, 8, 9, 10, and 11, with a percentage of many students who answered more than 50%. At the same time, the rest is

only less than 26% of students can solve the questions properly and correctly. In this case, when reviewed using a concept understanding score. The question understood by students with very high conceptual understanding is question number 8. This shows that students have a solid understanding of how to determine the speed of an object on a flat plane. However, questions with a very low understanding of students' concepts occur in questions 1 to 6. This shows that most students still do not understand the concept of Newton's law itself, especially in understanding the graph of the dependence of the resultant acting on objects as a function of time, determining the magnitude of the force. Object normal at a certain point, determine the tangential acceleration, determine the magnitude of the normal force at a certain point, describe the forces acting on the object, and calculate the resultant force on the object.

Qualitative Analysis of Concept Understanding and Activated Resource Theory

Students' conceptual understanding can be measured by using multiple-choice questions that are reasoned and given through a test. Students are asked to answer according to their abilities by giving reasons for the answers they choose. The reasons are then used to analyze the level of understanding of students' concepts on the topic of Newton's Laws.

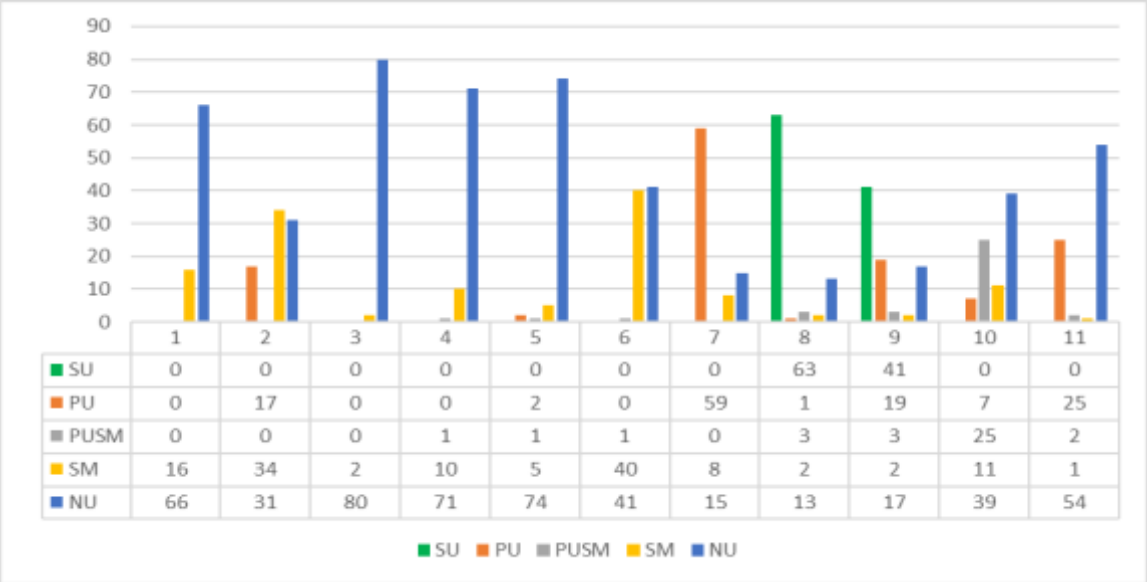
Analysis of the level of understanding of the concept describes the extent to which the level of understanding of students on a given topic. The level of understanding of the concept has been described in Table 1. Meanwhile, the results of the data on the level of student understanding are shown in Figure 2.

Figure 2 shows a summary of the level of understanding of students' concepts from the results of the analysis of answers to the tests given. From the data above, it can then be processed data on the level of understanding of students' concepts on the topic of Newton's Law, as shown in Figure 3.

Based on Figure 3, it can be concluded that the level of understanding of students' concepts on the topic of Newton's Law is still dominated by students who do not understand (No Understanding), with a percentage of 55.54%. This happens due to several factors that make students enter the level of understanding (NU). The indications found by the researchers were (1) students did not understand the intended problem and the required solution, (2) mastery of concepts regarding Newton's law theory was still fixed on one example and did not develop, and (3) imagination about the concept of force that occurred on something still floating. This assumption is also in line with research conducted by (Sari et al., 2018) , which shows that students have a very low level of understanding, with a percentage of students understanding concepts only 24.3%.

Meanwhile, students with a clear level of understanding (Specific Misconception) are above students who have a steady level of understanding (SU) & (PU) with a percentage of 14.52%. This shows that there are still many students who misinterpret Newton's law theory in its application and become concrete evidence that students do not understand the concepts taught by the teacher or even students cannot grasp the intent of the material presented by the teacher. The factors that indicate the emergence of misconceptions in students are learning methods that are not in accordance with student

criteria, considering that not all students have the speed to memorize and understanding the material at the same time. According to (Suparno, 2005), one of the causes of misconceptions in students is a learning method that emphasizes the teacher center, where the teacher teaches with lectures and writing, which is considered too monotonous. So that students quickly feel bored and become unfocused on learning which ultimately causes the concept that is conveyed or taught to students cannot to be conveyed as a whole or maximally, but only part of it is conveyed so that students experience misconceptions in the future.



	1	2	3	4	5	6	7	8	9	10	11
SU	0	0	0	0	0	0	0	63	41	0	0
PU	0	17	0	0	2	0	59	1	19	7	25
PUSM	0	0	0	1	1	1	0	3	3	25	2
SM	16	34	2	10	5	40	8	2	2	11	1
NU	66	31	80	71	74	41	15	13	17	39	54

Figure 2. Students' Level of Understanding

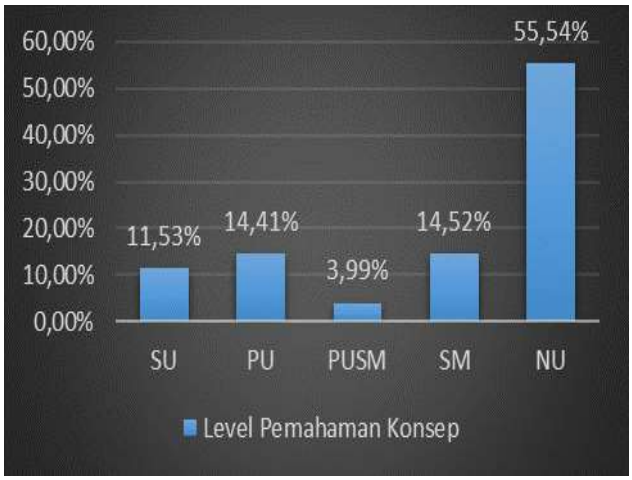


Figure 3. Percentage of Students' Concept Understanding Level on the topic of Newton's Law.

In presenting more detailed results regarding the problems that caused students to experience misconceptions and misunderstandings about Newton's Law theory, the researchers took several samples of the results of students' answers to be described. The selection of the questions is taken on questions number 1,4, and 6 with consideration of

the percentage of students' correct answers that are the least. Question number 1 and the reasons for student answers are shown in Figure 4 and Table 3.

Figure 4. Test Question Number 1

Table 5. Results of Analysis of Student Answers

Conceptul understanding level	Selected option	Reason	N (%)
SU	E = 0	Write the equation $F = m\frac{\Delta v}{\Delta t}$; $F \neq 0$ if $\Delta v \neq 0$; when v is constant then $\Delta v = 0$, then $F = 0$	0 (0%)
PU	-	-	0 (0%)
PUSM	-	-	0 (0%)
SM	C=1	Because when the initial velocity $V_0=0$, then the velocity Vt=Constant	1 (1,22%)
	A=2	Because the greater the resultant force (F_R) acting on the object, the greater the time required.	2 (2,24%)
	A=1	Because when $\sum F = 0$, then the resultant force $(F_R) = 0$	1 (1,22%)
	D=1	Because GLB shows the same picture	1 (1,22%)
	C=1	Writing equations $v = \frac{s}{t}$, $s = v.t, w = f.s$	1 (1,22%)
	D=1	Because it resembles the graph of the problem	1 (1,22%)
	D = 1	Writing equations $F = \frac{v}{t}$	1 (1,22%)
	D = 1	Writing equations $\frac{F}{t} x \frac{F}{t} = \frac{f}{t}$; If the resultant force stops, then the acceleration of time moves.	1 (1,22%)
	D = 4 B = 1	Because it is based on Newton's first law. An object that is at rest with velocity = 0, then the object will remain	5 (6,10%)

	D = 1	at rest. Because it is studied on Newton's first law.	1 (1,22%)
	C = 1	Since the line is GLBB	1 (1,22%)
NU	D=25 C=5 B=9 A=12 E=4 11	Repeating questions, don't understand, and don't answer	66 (80,49%)

Based on Figure 4 and Table 3 above, what is shown in this problem shows students solving problems about the resultant dependence graph acting on objects. From the results of the analysis, there were no students who could answer this question, either understanding Steady (SU), partial understanding (PU), or partial understanding with misconceptions (PUSM). This is concrete evidence that none of the students (0%) understand the real concept of this problem. At the level of understanding specific misconceptions, 16 students (19,51%) gave incorrect reasons. One of them is in the following student answers, shown in Figure 5.

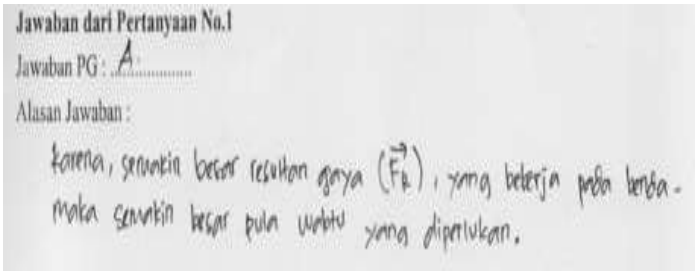


Figure 5. Reason for one of the students in the category of Specific Misconception in question number 1

Based on Figure 5. it is known that students gave the wrong answers to the concept. According to students, the greater the resultant force (FR) on an object, the greater the time required. While looking at the original equation, the value of $F = \frac{\Delta v}{\Delta t}$; where $F \neq 0$ if $\Delta v \neq 0$; and when v = constant, then $\Delta v = 0$, and $F = 0$. So it can be said that the force F is inversely proportional to the function of time. This is inversely proportional to the student's statement, which means that the force F is directly proportional to the function of time. On the other hand, some students give reasons for answers that are by the original rules but are incomplete and wrong in choosing the answer options. This is shown in Figure 6.

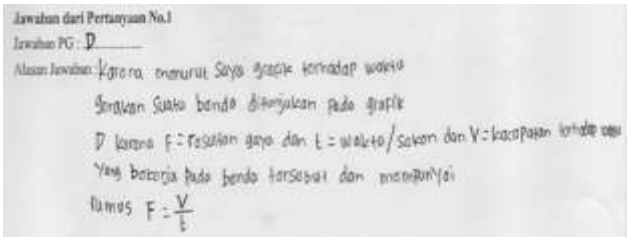


Figure 6. Reason for one of the students in the category of Specific Misconception in question number 1

Figure 6 shows that students give answers close to the original rules but incomplete and choose the wrong answer option. As for the other students, many gave answers that were not by the original rules. And the remaining 66 students (80.49%) are at the level of not understanding, not giving reasons and answers, or just repeating questions.

Based on the results of the analysis above, it can be seen that the Resource failed to be activated by showing an error in providing an incorrect answer to the basic rules. This is in line with research (M. Taqwa, 2017) which states that university-level students still have many difficulties in determining the direction of the force acting on an object. Of course, this is also a factor that affects students' understanding of the dependence of the resultant acting on objects.

Next, question number 4 will be shown, which has the lowest percentage and level of student understanding based on the reasons given, as shown in Figure 7.

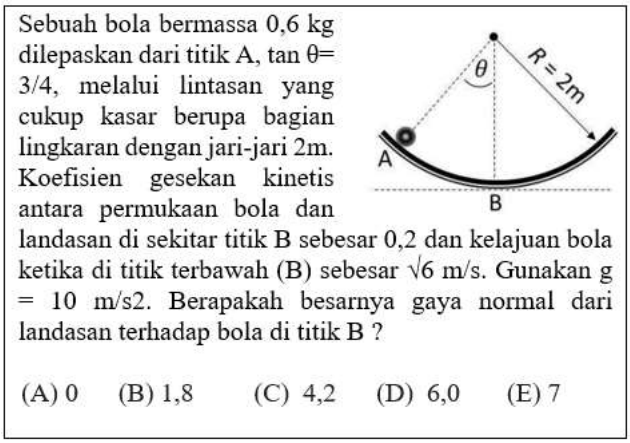


Figure 7. Test Question Number 4

Table 6. Results of Analysis of Student Answers

Conceptula understanding level	Selected option	Reason	N (%)
SU	E = 0	Writing equations $\Sigma F = m.a_s$; $N - w = m.\frac{v^2}{R}$	0 (0%)
PU	-	-	0 (0%)
PUSM	B=1	Writes the equation $\Sigma F = m.a_s$, ut says that $N = m.\frac{v^2}{R}$	0 (0%)
SM	A=2 B=2	Writes the equation $v_s = m.\frac{m.F^2}{r}$	4 (4,88%)
	D=5 A=1	Writes the equation $N = m.g$	6 (7,32%)
NU	A=5 B=10	Repeating questions, don't understand, and don't answer	71 (86,59%)

C=10 D=4 E=1 41	

Based on Figure 7 and Table 6 above, students are asked to determine the magnitude of the normal force on an object at a certain point. From the analysis results, most students are at the level of not understanding (NU) with 86.59%. However, when viewed from the multiple choice options, one student chose the correct option (1,22%) but was not equipped with a reason. This can happen if students only answer or guess correctly but do not understand what must be explained. This lack of student knowledge can occur if the knowledge conveyed by the teacher cannot be defined and imagined in the student's mindset, so most students will only guess the answers they do not know. This is also in line with research (Saputra, 2018) which says that the ability of teaching teachers is also an important factor in understanding students' concepts.

Another factor that makes the student not understand or cannot solve the problem correctly is that the teaching system still uses conventional methods and is not balanced with experiments (Saputra, 2018). The use of conventional methods by teachers when dealing with abstract concepts often uses analogies. If the analogy used is not by the original concept, it will lead to misconceptions. This incident was shown to a number of students who answered questions with a Specific Misconception level with a percentage of 12.20% or as many as ten students. None of the student's answers are correct, even if it is seen from the multiple choice answers. However, suppose it is seen from the reasons students answer. In that case, there is a specific misconception among students because the reasons given are not by the original rules as one of the answers from students is shown in Figure 8 below.

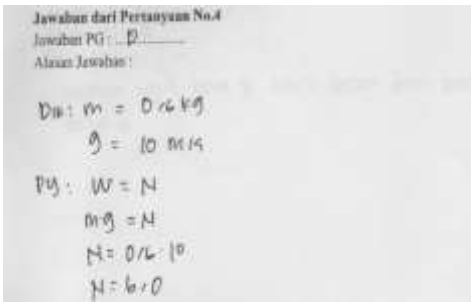


Figure 8. Reason for one of the students in the category of Specific Misconception in question number 4

Based on the picture above, the answer option D became the dominant one, with the number of students choosing as many as five people. Even though the answer is incorrect, the students give reasons by writing the equation $N = w$; $N = m.g$. However, this analogy is not correct. Students should write an equation that fits the concept, namely $-w = m.\frac{v^2}{R}$. This can happen due to students using the wrong analogy or failing to activate the equation. This is also in line with the opinion (Suparno, 2005), that using analogies in concept learning can help make it easier for students to understand concepts, but sometimes it causes misconceptions.

Next will be shown question number 6, which has the lowest percentage and level of understanding of students based on the reasons given, as shown in Figure 9 and Table 7.

Dua bola identik memiliki bergerak saling mendekat di atas lantai licin. Bola A memiliki laju v dan bola B memiliki laju 2v seperti gambar.

Pada saat bertabrakan, maka…
(A) Bola A memberi gaya dorong yang lebih besar ke bola B.
(B) Bola B memberi gaya dorong yang lebih besar ke bola A.
(C) Bola A dan B saling memberi gaya dorong yang sama besar.
(D) Jawaban (A), (B), dan (C) mungkin benar.
(E) Gaya dorong pada tiap bola tidak dapat ditentukan.

Figure 9. Test Question Number 6

Table 7. Results of Student Answer Analysis

Conceptula understanding level	Selected option	Reason	N (%)
SU	C = 0	When two objects touch / collide, then the magnitude of the thrust given by each object is the same	0 (0%)
PU	-	-	0 (0%)
PUSM	C=1	When two objects touch / collide, then the magnitude of the thrust given by each object is the same	1 (1,22%)
SM	A=1	Because ball B has a faster speed than ball A	36 (43,90%)
	B=35 B=2	Because ball B has a larger volume than ball Karena bola B lebih besar daripada bola A	2 (2,24%)
	B=1	Because it has a greater value (2v) while the ball A	1 (1,22%)
	B=1	only has frequency (v)	1 (1,22%)
NU	A=4 B=8 C=1 D=3 E=1 24	Repeating questions and not answering	41 (50,00%)

Based on Figure 9 and Table 7 shown. Students' level of understanding is still in the lowest third rank, namely at the level of partial understanding with specific misconceptions (PUSM) as many as one students (1.22%). Students already have an

understanding that is by the original rules, but there are additional perceptions that make the answer awkward. The answers given by students are shown in Figure 10.

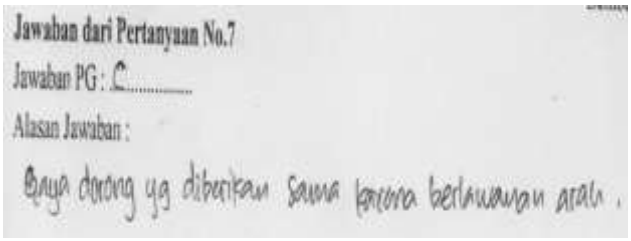


Figure 10. The reason for one of the students in the category of Specific Misconception in question number 6

If seen from Figure 10. The multiple choice options selected are correct and the reasons for the answers are appropriate, but there is an additional word "opposite direction" making the reason for the answer to be misunderstood or a misconception. This misconception occurs because students assume that the colliding balls are balls that are in opposite directions and produce the same magnitude of force. However, this can be a misconception if it is used as an analogy for other students. Furthermore, the level of understanding of specific misconceptions (SM) occurred in 40 students (48.78%) who still thought that a ball with a larger speed and size would exert a greater force on a smaller object or ball. While the original rule is that when two balls collide with each other, the magnitude of the thrust given by each object is the same, this is in accordance with the original concept of Newton's third law where action equals reaction. In line with research conducted by (Sandra et al., 2018) which states that many students experience misconceptions in Newton's First Law and Newton's Third Law. According to him, the misconception is caused by less meaningful learning and most of the practice questions tend to be based on a mathematical approach rather than a conceptual one. While the level of not understanding (NU) occurred in 41 students (50%) by only choosing the answer option without giving a reason for the answer.

CONCLUSION

Based on the research and discussion results, it can be concluded that many students still experience very low conceptual understanding with an average of 37.58. This is shown from the 11 questions given only 5 that can be answered correctly by more than 50% of students. While the 6 questions of students are less than 30% of students who can answer it correctly. However, only 11.53% of students can answer correctly and are accompanied by reasons by scientific concepts. The reasons given in answering indicate the existence of misconceptions experienced by students with a percentage of 14.52%. While the remaining 55.54% indicates that students are at the level of not understanding by showing students' answers without giving reasons. The results showed that many students still had difficulties and experienced misconceptions about the topic of Newton's Law. Considering these misconceptions and misunderstandings can occur due to many factors, it is necessary to approach students to understand students understanding of concepts directly and find out what obstacles students experience when

learning. Is it because the material presented is not fully described in the minds of students, because the learning methods required for each student are different, or because the methods provided by the teacher do not attract students' attention.

REFERENCES

Anggereni, S., & Khairurradzikin, K. (2016). Efektivitas Pembelajaran Menggunakan Media Pembelajaran Macromedia Flash Dalam Meningkatkan Pemahaman Konsep Fisika Materi Hukum Newton. *Jurnal Biotek*, *4*(2), 333–350. https://doi.org/10.24252/JB.V4I2.1890

Diani, R., Latifah, S., Anggraeni, Y. M., & Fujiani, D. (2018). Physics Learning Based on Virtual Laboratory to Remediate Misconception in Fluid Material. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *3*(2), 167. https://doi.org/10.24042/TADRIS.V3I2.3321

Dimas, A. (2020). Pemahaman Konsep Mahasiswa IPA pada materi Hukum Newton. *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan*, *6*(4), 11–14.

diSessa, A. A. (2018). *A Friendly Introduction to "Knowledge in Pieces": Modeling Types of Knowledge and Their Roles in Learning*. 65–84. https://doi.org/10.1007/978-3-319-72170-5_5

Fadlli, M. R., Sutopo, S., & Wartono, W. (2019). Analisis Kesulitan Siswa dalam Menyelesaikan Soal Hukum Newton. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(8), 993–997.

Gercek, C., & Ozcan, O. (2015). Views of Biology Teacher Candidates about Context Based Approach. *Procedia - Social and Behavioral Sciences*, *197*, 810–814. https://doi.org/10.1016/J.SBSPRO.2015.07.190

Hamdani, D., Kurniati, E., & Sakti, I. (2014). Pengaruh Model Pembelajaran Generatif Dengan Menggunakan Alat Peraga Terhadap Pemahaman Konsep Cahaya Kelas Viii Di Smp Negeri 7 Kota Bengkulu - Unib Scholar Repository. *Pendidikan Fisika*, 79–88.

Hammer, D. (2000). Student resources for learning introductory physics. *American Journal of Physics*, *68*(S1), S52–S59. https://doi.org/10.1119/1.19520

Handhika, J., Cari, C., Soeparmi, A., & Sunarno, W. (2016). Student conception and perception of Newton's law. *AIP Conference Proceedings*, *1708*(February). https://doi.org/10.1063/1.4941178

Hau, R. R. H., & Nuri, N. (2019). Pemahaman Siswa terhadap Konsep Hukum I Newton. *Variabel*, *2*(2), 56–61. https://doi.org/10.26737/VAR.V2I2.1815

Hijriani, H., & Hatibe, H. A. (2021). Analisis Kesulitan Belajar Dalam Memecahkan Masalah Fisika Pada Materi Hukum Newton Tentang Gerak. *JPFT (Jurnal Pendidikan Fisika Tadulako Online)*, *9*(1), 45–49.

Huberman, A. M., & Miles, M. . . (1994). Data management and analysis methods. - PsycNET. In In N. K. Denzin & Y. S. Lincln (Eds) (Ed.), *Handbook of qualitatif research* (pp. 428–444). Sage Publication, Inc.

Juliartini, N. M., Hatibe, A., & Darsikin, D. (2020). Analisis Kesulitan Siswa SMA Dalam Memahami Konsep Hukum Newton. *Musamus Journal of Science Education*, *2*(2), 81–90. https://doi.org/10.35724/MJOSE.V2I2.3025

Lestari, F., Sudirman, S., & Murniati, M. (2018). *Analisis Kesulitan Siswa Dalam Mengerjakan Soal-Soal Fisika Pokok Bahasan Hukum Newton Di Kelas X Sma Negeri 1 Indralaya*.

Mardiyah, A., Ariaji, R., Kimia, P., & Universitas Muhammadiyah Tapanuli Selatan, F.

(2017). Peningkatan Pemahaman Konsep Fisika Dan Aktivitas Mahasiswa Melalui Phet Simulation Pendidikan Fisika, Fkip Universitas Muhammadiyah Tapanuli Selatan 2. *Pendidikan*, *1*.

Mulyastuti, H., & Taufiq, A. (2018). Identifikasi Resource Siswa Materi Kesetimbangan dan Titik Pusat Massa. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(5), 598–602.

Nadhor, N., & Taqwa, M. R. A. (2020). Pemahaman Konsep Kinematika Mahasiswa Calon Guru Fisika: Ditinjau dari Level Pemahaman dan Teori Resource. *PENDIPA Journal of Science Education*, *4*(3), 82–90. https://doi.org/10.33369/pendipa.4.3.82-90

Novitasari, N. (2016). Profil Kemampuan Memahami Materi Dinamika Partikel Pada Siswa Sma Kelas X. *Prosiding Seminar Nasional Fisika (E-Journal)*, *5*, SNF2016-OER-41–44. https://doi.org/10.21009/0305010407

Panprueksa, K., Phonphok, N., Boonprakob, M., & Dahsah, C. (2012). Thai Students' Conceptual Understanding on Force and Motion. *International Conference on Education and Management Innovation IPEDR Vol.30 (2012) © (2012) IACSIT Press, Singapore*, *30*, 275–279.

Rivaldo, L., Reyza, M., Taqwa, A., & Taurusi, T. (2019). *Jurnal Pendidikan Fisika Universitas Muhammadiyah Makassar Resources Siswa SMA tentang Konsep Gaya Archimedes*. *6*, 8.

Saglam-Arslan, A., & Devecioglu, Y. (2010). Student teachers' levels of understanding and model of understanding about Newton's laws of motion. *Asia-Pacific Forum on Science Learning and Teaching*, *11*(1), 1–20.

Saputra, H. (2018). ANALISIS KONSEPSI SISWA KONSEP DINAMIKA GERAK. *Jurnal Pendidikan Fisika Dan Sains*, *1*(01), 21–31.

Saputri, D. E., Taqwa, M. R. A., Aini, F. N., Shodiqin, I., & Rivaldo, L. (2019). Pemahaman konsep mekanika: menentukan arah percepatan pendulum, sulitkah? *Jurnal Pendidikan Fisika Dan Teknologi*, *5*(1), 110–117. https://doi.org/10.29303/jpft.v5i1.1134

Sari, A. L. R., Parno, P., & Taufiq, A. (2018). Pemahaman Konsep dan Kesulitan Siswa SMA pada Materi Hukum Newton. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(10), 1323–1330. https://doi.org/10.17977/JPTPP.V3I10.11663

Simanjuntak, M. P. (2012). Peningkatan Pemahaman Konsep Fisika Mahasiswa Melalui Pendekatan Pembelajaran Pemecahan Masalah Berbasis Video - Digital Repository Universitas Negeri Medan. *Pendidikan Fisika*.

Suparno, P. (2005). *Miskonsepsi & Perubahan Konsep Pendidikan Fisika.* PT. Gramedia Widiasara Indonesia.

Suraji, S., Maimunah, M., & Saragih, S. (2018). Analisis Kemampuan Pemahaman Konsep Matematis dan Kemampuan Pemecahan Masalah Matematis Siswa SMP pada Materi Sistem Persamaan Linear Dua Variabel (SPLDV). *Suska Journal of Mathematics Education*, *4*(1), 9–16. https://doi.org/10.24014/SJME.V4I1.5057

Taqwa, M. (2017). *Profil Pemahaman Konsep Mahasiswa dalam Menentukan Arah Resultan Gaya*. 79–87.

Taqwa, M. R. A. (2017). Profil Pemahaman Konsep Mahasiswa dalam Menentukan Arah Resultan Gaya. *Prosiding Seminar Nasional Pendidikan Sains*, 79–87.

Taqwa, M. R. A., & Faizah, R. (2016). Perlunya Program Resitasi dalam Meningkatkan Penguasaan Konsep Dinamika Partikel Mahasiswa. *Seminar Nasional Pembelajaran Ipa Ke-1*, *May*, 482–487. https://www.researchgate.net/profile/Muhammad-Taqwa-

3/publication/325357660_Perlunya_Program_Resitasi_dalam_Meningkatkan_Penguasaan_Konsep_Dinamika_Partikel_Mahasiswa/links/5b0763a3aca2725783e24d4a/Perlunya-Program-Resitasi-dalam-Meningkatkan-Penguasaan-K

Taqwa, M. R. A., & Pilendia, D. (2018). Kekeliruan Memahami Konsep Gaya , Apakah Pasti Miskonsepsi ? *Jurnal Inovasi Pendidikan Fisika Dan Integrasinya*, *01*(02), 1–12.

Taqwa, M. R. A., Sulman, F., & Faizah, R. (2022). College Students ' Conceptual Understanding of Force and Motion : Research Focus on Resource Theory. *Journal of Physics: Conference Series*, *2309*(012073), 1–9. https://doi.org/10.1088/1742-6596/2309/1/012073

Wahyuni, I. H. W. (2021). *identifikasi pemahaman konsep mahasiswa pada topik pemantulan dan pembiasan, ditinjau dari level pemahaman konsep dan teori resource / ike hilma wahyuni*.

Yusuf, A. M. (2017). *Metode Penelitian Kuantitatif, Kualitatif & Penelitian Gabungan - Prof. Dr. A. Muri Yusuf, M.Pd. - Google Buku* (Edisi 1). KENCANA.