

## IDENTIFICATION OF MISCONCEPTIONS IN PHYSICS LEARNING

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### ABSTRACT

This research aims to determine students' understanding of concepts and misconceptions that occur in class X SMA students in Medan City regarding parabolic motion. This type of research is included in descriptive research. Based on the regional sample used in this research, the schools selected were located in the city center, mid-city and suburbs, namely SMAN 18, SMAN 7 and SMAN 11 Medan respectively. The number of samples taken by each school was SMAN 18 with 36 students, SMAN 7 with 36 students, and SMAN 11 with 36 students. The research instrument is in the form of reasoned multiple choice questions totaling 15 questions. Before these test questions are used, the instrument is first validated by experts. After the tests were carried out in three schools, the data was analyzed using the CRI (Certainty of Response Index) method. The research results obtained showed that the misconceptions experienced at SMAN 18 Medan were 52.59%, at SMAN 7 Medan it was 60.37% and at SMAN 11 Medan it was 41.11%. It was concluded that misconceptions among class

**Keywords:** *Misconceptions, parabolic motion, concept understanding*

### INTRODUCTION

Education is an applied form of human culture that is dynamic and continues to develop. Changes or improvements in the world of education today should occur along with changes in lifestyle. Law Number 20 of 2003 concerning the General Framework for Education stipulates that the capacity of state schools is to pay attention to the state's scientific existence, develop abilities and form respectable people and civilization in the country. The motivation behind education is to develop students' abilities to become people who are receptive, devoted to God Almighty, dignified, healthy, educated, skilled, imaginative, independent and become reliable rulers of the majority and population. Ongoing changes exist to support future development. One of them is the learning process activity. In Dahar's 2011 book, it is stated that learning is a process of interaction between teachers and students.

One of the goals of science learning is for students to understand concepts, apply concepts, and be able to relate one concept to another. In this learning process, students should understand the concepts being taught, not just memorize them. One of them is physics, this learning does not only discuss speed and calculation skills, but what is more important is how to instill physics concepts in students. Students' ability to understand concepts is very important because concepts are the basis for thinking.

During the learning process, students are always guided to understand the learning material as fully as possible. In reality, students do not always absorb information completely during the learning process, especially in physics subjects which contain many scientific concepts (Syahrul & Setyarsih, 2015), identifying student concepts, teacher concepts, and scientist concepts in physics learning. If someone describes or views these three concepts differently, then this can be said to be a misconception. Samatowa 2010 states that students' learning abilities and the content students learn depend on the concepts contained in students' previous experiences. The occurrence of misconceptions can actually be influenced or rooted in many factors, including: differences in opinion from the students themselves, the teaching methods used by teachers, and learning resources or books that students read. There are misconceptions because there is a lack of attention to students' preconceptions or original conceptions. Physics misconceptions can happen to anyone at any level of education, be it elementary school students, high school students, university students, even teachers or lecturers. (Mosik & Maulana, 2010; Saregar, 2016)

Misconceptions experienced by students are usually caused by teachers providing incomplete concepts or facts, so that students become confused when accepting these concepts. Usually students think that everything the teacher conveys is correct, if the concepts conveyed by the teacher are not correct it will have a bad impact on the students. For example, students know that the trajectory of an object dropped from an airplane moving above the earth's surface will be vertical downwards. It is very important for teachers to pay attention when teaching concepts to students so that there are no misconceptions or misunderstandings.

Identification of misconceptions has been widely carried out, but it is still difficult to distinguish between students who experience misconceptions and students who do not understand the concept. If an error occurs, it will also have an impact on how it is handled, because students who find the concept wrong will be handled differently from students who do not know the concept. If not addressed immediately, students will continue to harbor misconceptions, making it difficult for teachers to change or correct these misconceptions as the learning process progresses. Apart from that, this is also reinforced by the low test scores on physics material which proves that there are still many students who misunderstand, misunderstandings caused by students are influenced by many factors and occur without them being directly aware of it. Therefore, it is necessary to identify whether students have misconceptions or not.

Based on interviews with several high schools in Medan City, researchers found that students' daily test scores in physics subjects were very low so that there were still students who did not understand the minimum completion standard, namely  $\geq 75$ . Therefore, students' understanding of the Parabolic Motion material is still lacking, in the process of solving problems students will still make mistakes, it can be said that students have misconceptions. Based on this background, researchers are interested in conducting research with the title "Identification of Misconceptions in Parabolic Motion Material for Class X Students in Medan City".

## RESEARCH METHODS

The type used in this research is descriptive research. This research was carried out in several high schools in Medan City in the odd semester of the 2023/2024 academic year. The technique used to take samples in this research is the regional sampling method. The selected high schools represent three regional categories in the city of Medan, namely the city center, mid-city and suburban areas. Each region has one high school, namely the State High School in each region. SMA Negeri 18 for the city center area, SMA Negeri 7 Medan for the mid-city area, and SMA Negeri 11 Medan for the suburban area. The class sampling used was the cluster random sampling technique. With one class of subjects studied per school, they were chosen randomly with the assumption that all classes were homogeneous. The class chosen is class X which has studied Parabolic Motion material. Data collection techniques are a stage that needs to be carried out in order to collect the data needed in research, both by using test and non-test instruments. The data collection technique that will be carried out uses a written test technique.

The test used in this research is a written test which is similar to the learning outcomes test in the form of an open-ended multiple choice test accompanied by a confidence level column or CRI (Certainty Response Index) which aims to identify conceptual errors in the Parabolic Motion material for class X students at Medan City High School. Data collection was carried out using the following instruments:

The instrument used in this research is open-ended multiple choice questions accompanied by a CRI (Certainty Response Index) form which is used to determine whether there are misconceptions in students. Each question item used in this research instrument has 4 answer choices. Tests with four answer choices are widely used because they allow students to guess about 25% of the answers. This research instrument functions to diagnose/identify students' misconceptions, so that the instrument preparation technique used refers to the stages of preparing a diagnostic test as follows:

1. Determining Competency Standards, Basic Competencies, and Question Indicators
2. Determining Test Objectives with an approach to errors commonly made by students
3. Preparation of the Question Instrument Grid
4. Preparation of Draft Question Instruments
5. Validation of Question Instruments by Lecturer. Validation of Physics Questions.

**RESULTS AND DISCUSSION**

**• Research result**

Based on research results from state high schools in the city of Medan, namely SMAN 7, SMAN 11, and SMAN 18. The sample size for each school was 36 students at SMAN 7, 36 students at SMAN 11, and 36 students at SMAN 18. The test given is a 15-question diagnostic test consisting of 15 multiple choice questions accompanied by a CRI column (level of confidence in the answer). The test given is a test on the main material of parabolic motion.

The results of the students' work on the questions were analyzed and the results are as shown in the table below:

**Table 1.** Profile of understanding concepts at SMAN Medan (SMA 7, SMA 11, SMA 18)

Noitem	Profile					
	Don't know the concept		Misconceptions		Know the concept	
	Amount	%	Amount	%	Amount	%
1	15	13.88	26	24.07	67	62.03
2	28	25.92	36	33.33	48	44.44
3	20	18.51	84	77.77	14	12.96
4	26	24.07	56	54.62	26	24.07
5	39	63.88	13	12.03	56	54.62
6	30	27.77	49	45.37	29	26.85
7	38	35.18	60	55.55	10	9.25
8	30	27.77	65	60.18	13	12.03
9	23	21.29	81	75	4	3.70
10	26	24.07	55	50.92	27	25
11	34	31.48	55	50.92	19	17.59
12	35	32.4	51	47.22	22	20.37
13	23	21.29	64	59.25	21	19.44
14	32	29.62	72	66.66	4	3.70
15	28	25.92	55	50.92	5	4.62
Amount	427	.	822	.	365	.

**• Discussion**

**Question no. 1 (factors that influence the height of an object)**

Based on the data obtained, for SMAN 7 Medan there were 11.1% of students who did not know the concept at all, 16.6% had misconceptions and 72.2% of students who knew the concept. For SMAN 11 Medan, there were 25% of students who did not know the concept at all, 8.3% had misconceptions and 66.6% of students who knew the concept. For SMAN 18 Medan 5.5% of students do not know the concept, 47.2% of students experience misconceptions and 47.2% of students know the concept. In this question, students at SMAN 18 have more dominant misconceptions, where students think that final speed is a factor that influences the height of an object experiencing parabolic motion.

**Question no. 2 (initial speed and elevation angle at the highest point of kinetic energy)**

Based on the data obtained, for SMAN 7 Medan there were 55.5% of students who did not know the concept of sams at all, 25.6% experienced misconceptions and 16.6% of students who knew the concept. For SMAN 11 Medan, 16.6% of students did not know the concept at all, 11.1% had misconceptions and 72.2% of students knew the concept. For SMAN 18 Medan, 33.3% of students do not know the concept at all, 61.1% experience misconceptions and 5.5% of students know the concept. When the highest point = 0 bullet speed =, then the speed is minimum. The

speed and elevation angle at the highest point mean that the kinetic energy of the bullet is the maximum potential energy.  $V_y, V_x$

**Question no. 3 (factors that influence the maximum distance traveled by an object experiencing parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 25% of students who did not know the concept at all, 61.1% had misconceptions and 13.8% of students who knew the concept. For SMAN 11 Medan, 22.5% of students did not know the concept at all, 72.2% had misconceptions and 5.5% of students knew the concept. For SMAN 18 Medan, 8.3% of students did not know the concept at all, 72.2% had misconceptions and 19.4% of students knew the concept. The most dominant form of misconception in this question is that students think that time during parabolic motion is a factor that influences the maximum distance an object can travel.

**Question no. 4 (the relationship between the initial speed of the object and the maximum height in parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 16.6% of students who did not know the concept at all, 77.7% had misconceptions and 5.5% of students who knew the concept. For SMAN 11 Medan, 22.5% of students did not know the concept at all, 30.5% had misconceptions and 47.2% of students knew the concept. For SMAN 18 Medan, 33.3% of students did not know the concept at all, 47.2% had misconceptions and 19.4% of students knew the concept. In parabolic motion, the greater the initial speed of the object, the higher the object will reach its maximum height. So the initial speed affects the maximum height of the object.

**Question no. 5 (central condition point in parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 55.5% of students who did not know the concept at all, 13.8% had misconceptions and 30.5% of students who knew the concept. For SMAN 11 Medan, 25.6% did not know the concept at all, 8.3% had misconceptions and 61.1% of students knew the concept. For SMAN 18 Medan there were 25% of students who did not know the concept at all, 13.8% had misconceptions and 61.1% of students knew the concept. For this question, SMAN 11 and SMAN 18 have mastered the central condition point in parabolic motion correctly, whereas for SMAN 7, most of them don't know the concept at all. There are equally high misconceptions at SMAN 7 and SMAN 18 to understand the three main condition points located at numbers 1, 3 and 5.

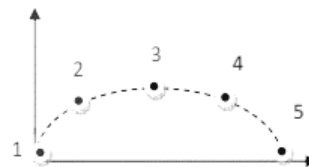


Figure 1. Question Number 5

**Question no. 6 (understanding parabolic motion in volleyball)**

Based on the data obtained, for SMAN 7 Medan there were 13.8% of students who did not know the concept at all, 83.3% had misconceptions and 2.7 students who knew the concept. For SMAN 11 Medan, 47.2% of students did not know the concept at all, 16.6% had misconceptions and 36.1% of students knew the concept. For SMAN 18 Medan, 22.5% of students did not know the concept at all, 36.1% and 41.6% of students knew the concept. In this question, a high level of misconception occurred at SMAN 7 Medan where students thought that GLBB was located on the same axis, namely the X axis and the Y axis.

**Question no.7 (speed of object moving with parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 41.6 students who did not know the concept at all, 58.3% had misconceptions and 0% of students knew the concept. For SMAN 11 Medan there were 25.6% of students who did not know the concept at all, 55.5% had misconceptions and 16.6% of students who knew the concept. For SMAN 18 Medan, 36.1% of students did not know the concept at all, 52.7% had misconceptions and 11.1% knew the concept. For SMAN 7, SMAN 11 and SMAN 18 there is almost the same misconception problem for this question where students assume that if an object reaches its highest point then the object moves in a parabolic motion when the object's speed is maximum.

**Question no. 8 (factors affecting final speed)**

Based on the data obtained, for SMAN 7 Medan there were 36.1% of students who did not know the concept at all, 63.8% had misconceptions and 0% of students knew the concept. For

SMAN 11 Mean there are 22.5% of students who do not know the concept at all, 66.6% have misconceptions and 11.1% of students who know the concept. For SMAN 18 Medan 25% of students do not know the concept at all, 46.1% experience misconceptions and 25% know the concept. In parabolic motion, the final speed is influenced by the initial speed, elevation angle, height and gravitational acceleration.

**Question no. 9 (components of parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 13.8% of students who did not know the concept at all, 86.1% had misconceptions and 0% of students knew the concept. For SMAN 11 Medan, there were 25.6% of students who did not know the concept at all, 66.6% had misconceptions and 5.5% of students who knew the concept. For SMAN 18 Medan 22.5% of students do not know the concept at all, 72.2% experience misconceptions and 5.5% of students know the concept. In this question, most students experience misconceptions in remembering the components of parabolic motion.

**Question no. 10 (maximum height reached by a kicked ball)**

Based on the data obtained, for SMAN 7 Medan there were 19.4% of students who did not know the concept at all, 80.5% had misconceptions and 0% of students knew the concept. For SMAN 11 Medan there are 25% of students who do not know the concept at all, 25% have misconceptions and 46.1% of students who know the concept. For SMAN 18 Medan 25.6% of students do not know the concept at all, 47.2% experience misconceptions and 25% of students know the concept. For this question, the average student at SMAN 11 can master the maximum height reached by a kicked ball well, while at SMAN 7 students have very high misconceptions.

**Question no. 11 (physical quantities in parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 25.6% of students who did not know the concept at all, 72.2% had misconceptions and 0% of students knew the concept. For SMAN 11 Medan, there were 38.8% of students who did not know the concept at all, 25% had misconceptions and 36.1% of students who knew the concept. For SMAN 18 Medan 25.6% of students do not know the concept at all, 55.5% of students experience misconceptions and 16.6% of students know the concept. The highest misconceptions appeared at SMAN 7, while at SMAN 11 and SMAN 18 they experienced the same problem, namely not knowing the concept at all.

**Question no. 12 (application of ball motion in everyday life)**

Based on the data obtained, for SMAN 7 Medan there were 38.8% of students who did not know the concept at all, 52.7% had misconceptions and 8.3% of students who knew the concept. For SMAN 11 Medan there were 38.8% of students who did not know the concept at all, 52.7% had misconceptions and 8.3% of students who knew the concept. For SMAN 18 Medan 19.4% of students do not know the concept at all, 36.1% of students experience misconceptions and 44.4% of students know the concept.

**Question no. 13 (quantities in parabolic motion and the relationship with their magnitudes)**

Based on the data obtained, for SMAN 7 Medan there were 16.6% of students who did not know the concept at all, 61.1% had misconceptions and 22.5% of students knew the concept. For SMAN 11 Medan there were 25% of students who did not know the concept at all, 55.5% had misconceptions and 19.4% of students who knew the concept. For SMAN 18 Medan 22.5% of students do not know the concept at all, 61.1% of students experience misconceptions and 16.6% of students know the concept. In this problem, most students experience misconceptions in determining the player who will get the maximum distance in a parabolic motion.

**Question no. 14 (a quantity that is always constant in parabolic motion)**

Based on the data obtained, for SMAN 7 Medan there were 30.5% of students who did not know the concept at all, 69.4% had misconceptions and 0% of students knew the concept. For SMAN 11 Medan, there were 25% of students who did not know the concept at all, 66.6% had misconceptions and 8.3% of students who knew the concept. For SMAN 18 Medan 33.3% of students do not know the concept at all, 63.8% of students experience misconceptions and 2.7% of students know the concept. Students assume that the quantity that is always constant is the acceleration on the x-axis. The correct one is the acceleration on the y-axis, namely the acceleration due to gravity  $g=10 \text{ m/s}^2$ .

**Question no. 15 (inconstancy of an object moving along a parabolic motion path)**

Based on the data obtained, for SMAN 7 Medan there were 19.4% of students who did not know the concept at all, 80.5% had misconceptions and 0% of students knew the concept. For SMAN 11 Medan there were 30.5% of students who did not know the concept at all, 55.5% had

misconceptions and 13.8% of students who knew the concept. For SMAN 18 Medan 25.6% of students do not know the concept at all, 72.2% of students experience misconceptions and 0% of students know the concept. In this question, students assume that the inconsistencies of objects moving on a track are speed and gravitational acceleration, but the correct ones are as follows: because of speed, the  $v_x$  value is constant, but the  $v_y$  value is influenced by time ( $t$ ), so the speed value is not constant. And the vertical component of speed,  $v_y = v \cdot \sin \alpha - gt$  whose value is influenced by time ( $t$ ) and cannot be constant.

## CONCLUSION

Based on the results of the analysis carried out at SMAN 7 Medan, the results showed that 60.37% had misconceptions, 28.14% did not know the concept, and only 11.48% understood the concept correctly. For SMAN 11 Medan, the misconceptions that occurred were 41.11%, 28.14% did not know the concept, and 30.74% understood the concept correctly. For SMAN 18 Medan, the misconceptions that occurred were 52.59%, 24.62% did not know the concept, and 22.77% understood the concept correctly. So it can be concluded that physics misconceptions in the city of Medan are still very high, namely greater than 40% and are a very serious problem faced by physics teachers.

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