

ERROR IN FIGURES OF PHYSICS TEXTBOOKS FOR 10TH GRADE IN HIGH SCHOOL

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Abstract

This research aims to show the error in figures of physics textbooks for 10th grade high school Physics textbooks on Newton's Law topic. Data collecting technique is a literature review and Physicists interview. Concepts in textbooks are compared to concepts in Physics University textbooks and clarified with the experts. Collecting data, reducing data, presenting data, concluding and verifying data are used as data analysis techniques. Based on the analysis result, error found in the figure of force diagram in three conditions of the object and in the figure of force diagram in the elevator in Pujianto, Risdiyani Chasanah, dan Supardianingsih' textbook, entitled Buku Siswa Fisika SMA/MA Kelas X published by Intan Pariwara on 2016. In Marthen Kanginan's textbook entitled FISIKA Untuk SMA/MA Kelas X published by Erlangga on 2016, error found in the figure of action-reaction force direction in the runner. In Ketut Kamajaya & Wawan Purnama's textbook entitled Buku Siswa Aktif dan Kreatif Belajar Fisika Untuk SMA/MA Kelas X which is published by Grafindo Media Pratama on 2016, error found in the figure of force diagram in the inclined surface.

Keywords : error, figures, textbook, Newton's Law.

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan kesalahan gambar yang terdapat pada buku Fisika SMA kelas 10 pada materi Hukum Newton. Data dikumpulkan melalui studi pustaka dan wawancara ahli Fisika. Data berupa konsep dalam buku ajar dibandingkan dengan konsep dalam buku Fisika Universitas dan diklarifikasi dengan wawancara para ahli. Teknik analisis data dalam beberapa tahap yaitu tahap pengumpulan data, tahap reduksi data, tahap penyajian data, penarikan kesimpulan dan verifikasi. Berdasarkan penelitian, pada Buku Siswa Fisika SMA/MA Kelas X karangan Pujianto, Risdiyani Chasanah, dan Supardianingsih penerbit Intan Pariwara tahun 2016 terdapat kesalahan gambar pada diagram gaya benda yang diberikan tiga keadaan berbeda serta pada diagram gaya ketika seseorang berada dalam lift. Pada buku ajar FISIKA untuk SMA/MA Kelas X karangan Marthen Kanginan penerbit Erlangga tahun 2016 kesalahan gambar terletak pada arah gaya aksi-reaksi pada pelari. Pada Buku Siswa Aktif dan Kreatif Belajar Fisika untuk SMA/MA Kelas X karangan Ketut Kamajaya & Wawan Purnama penerbit Grafindo Media Pratama tahun 2016 terdapat kesalahan gambar pada diagram gaya pada benda yang berada di bidang miring.

Kata Kunci : kesalahan, gambar, buku ajar, Hukum Newton

INTRODUCTION

Misconception can be interpreted as a concept that is not in accordance with the scientific understanding or understanding received by experts in that field (Suparno, 2013). Misconceptions definitely will hinder the process of new knowledge receiving and simulation within students, so that it will encourage students success in the further learning process (Setyarsih & Kuncoro, 2016). Misconception occur consistently in the students' mind (Wiyono *et al.*, 2016). In Physics learning of high school, there are many misconceptions in kinematics and dynamics (Pertiwi, C. A. & Setyarsih, W., 2016).

There are so many researches of Physics misconception, especially in the mechanics' field. This does not mean that the most misconceptions occur only in the field of mechanics, but so far, a lot of researches have been carried out in this field (Suparno, 2013) and until now it is still being an endless problem in the world of education (Sulistri & Lisdawati, 2017).

Understanding the concept of force in mechanics is very important because the foundation of the Physics concept is on the concept of force that exists in mechanics (Gumilar, 2016). The basis of mechanics is the three natural laws from Sir Isaac Newton in

Philosophiae Naturalis Principia Mathematica, namely Newton's Law (Sears & Zemansky, 1991). Newton's law has an important role in exploring natural phenomena, and it is important to see their attachment to other fundamental concepts in Physics (Fadaei & Mora, 2015). There are many researches that focus on student misconceptions, from children to secondary school students who experience misconceptions in mechanics, especially in Newton's Law (Fadaei & Mora, 2015).

The causes and sources that have the potential to cause a misunderstanding of concepts (misconceptions) also need to be identified (Gürel & Eryılmaz, 2013). One of the causes of misconceptions is textbook. Students earn misconceptions from Physics textbooks since misconceptions are presented as facts in textbooks and if a textbook has fewer errors (misconceptions), surely misconceptions will not spread widely (Gürel & Eryılmaz, 2013). Çobanoğlu & Şahin (2009) in their research found that misconceptions found in 10th grade in high school biology textbooks can influence the learning process. Özay & Hasenekoğlu (2007) found the issues that visual materials in 3 high school textbooks and concluded that the visual materials make it difficult for students to comprehend. Kearsy & Sheila (1999) also found misconceptions about the visual components.

Books that are widely used in schools and have been standardized by the National Standardization of Education Agency (BSNP) have found misconceptions in them (Shalihah et al., 2016). If a book that has the potential to cause misconceptions is widely used, it will adversely affect the knowledge of students throughout the country. In addition, if used by teachers and students as learning resources, teachers, and students will experience misconceptions or even strengthen previous misconceptions that have occurred (Resbiantoro & Nugraha, 2017). Then the steps to detect and correct errors or misconceptions in textbooks have an important role for students in understanding Physics concepts (Gürel & Eryılmaz, 2013).

Berg (1991) states that textbooks published by the government are often written suddenly without good trials so that more attention needs to be paid to the suitability of concepts in textbooks. Research on the existence of misconceptions found in Science textbooks (especially Physics) has not been done much (Suparno, 2013). Based on those considerations above, this research is carried out relating to the misconceptions found in 10th grade in High School Physics textbooks, especially the figures of Newton's Law topic.

METHODS

This research uses a qualitative research approach that delivers written word as descriptive data. In this

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study, three physics textbook is analyzed. They are Pujianto, Risdiyani Chasanah, dan Supardianingsih' textbook, entitled Buku Siswa Fisika SMA/MA Kelas X published by Intan Pariwara on 2016, Marthen Kanginan's textbook entitled FISIKA Untuk SMA/MA Kelas X published by Erlangga on 2016, and Ketut Kamajaya & Wawan Purnama's textbook entitled Buku Siswa Aktif dan Kreatif Belajar Fisika Untuk SMA/MA Kelas X which is published by Grafindo Media Pratama on 2016. Data collecting technique is a literature review and Physicists interview. Concepts in textbooks are compared to concepts in Physics University textbooks and clarified with the experts. Collecting data, reducing data, presenting data, concluding and verifying data are used as data analysis techniques (Sugiyono, 2016).

RESULTS & DISCUSSIONS

In Pujianto, Risdiyani Chasanah, dan Supardianingsih' textbook, entitled Buku Siswa Fisika SMA/MA Kelas X published by Intan Pariwara in 2016, there is an image like following

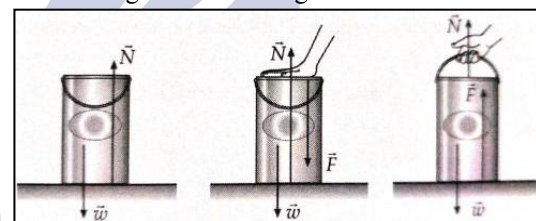
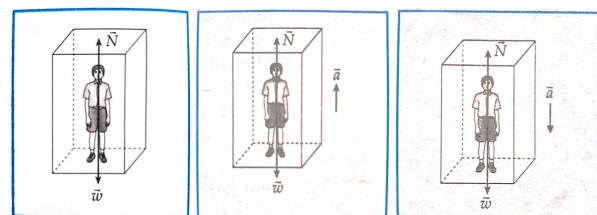


Figure 1. Force diagram in Book 1

The image is about force diagram in the object with 3 conditions. In that image, there is an error in the gravity vector line that is not right at the center of the object's mass and the vector length of force is less precise. The length of the line represents the magnitude and the line direction represents the vector direction (Young & Freedman, 2002). In the first state, the vector length of weight is shorter than the normal force. In this state, both forces have an equal magnitude because of the equilibrium state. In the third state, the position of normal symbol and force **F** from hand is exchanged. The vector length of weight shorter than force **F**. In this state, weight-length equal to the sum of normal force and force **F**. In this book, there is also an image like following



Sumber: Dokumen Penerbit

Gambar 7.22

Diagram gaya saat lift

Sumber: Dokumen Penerbit

Gambar 7.23

Diagram gaya saat lift naik

Sumber: Dokumen Penerbit

Gambar 7.24

Diagram gaya saat lift turun diam

Figure 2. Force diagram of elevator in Book 1

The image is about force diagram when someone is in the elevator. The elevator is in a motionless state, move upward, and move downward. In the image, there is no difference between normal and weight magnitude. The normal force is the reaction force from the person feet pressure (as action force) to the elevator. When the elevator moves upward, the normal force is greater and makes the person feels like his weight increase. When the elevator moves downward, the normal force is decreased and makes the person feels lighter. So, the normal force when the elevator moves upward is greater than the normal force when the elevator moves downward. When the elevator moves upward, the vector of the normal force is longer than the weight. When the elevator moves downward, the vector of weight is longer than the normal force.

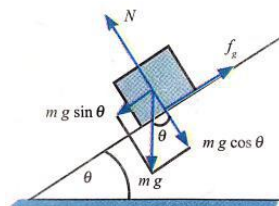
In Marthen Kanginan's textbook entitled FISIKA Untuk SMA/MA Kelas X published by Erlangga on 2016, there is an image like following



Figure 3. Action-reaction force in Book 2

The vector direction of the action-reaction force is not in the right position. Vector direction should be towards the front and back with the runner's foot pushes the start board back as an action force, and the start board pushes the runner forward as a reaction force so that the runner can move forward.

In Ketut Kamajaya & Wawan Purnama's textbook entitled Buku Siswa Aktif dan Kreatif Belajar Fisika Untuk SMA/MA Kelas X which is published by Grafindo Media. Pratama in 2016, there is an image like following



Gambar 7.22
Sebuah balok berada pada bidang miring yang kasar.

Figure 4. Force diagram in inclined surface in Book 3

In that image, the vector length of the friction force is longer than $mg \sin \theta$. When an object is in a rough field

with a certain slope, the object will move with $mg \sin \theta$ greater than the friction force.

CONCLUSION

Based on the analysis result, error found in the figure of force diagram in three conditions of the object and in the figure of force diagram in the elevator in Pujianto, Risdiyani Chasanah, dan Supardianingsih' textbook, entitled Buku Siswa Fisika SMA/MA Kelas X published by Intan Pariwara on 2016. In Marthen Kanginan's textbook entitled FISIKA Untuk SMA/MA Kelas X published by Erlangga on 2016, error found in the figure of action-reaction force direction in the runner. In Ketut Kamajaya & Wawan Purnama's textbook entitled Buku Siswa Aktif dan Kreatif Belajar Fisika Untuk SMA/MA Kelas X which is published by Grafindo Media Pratama on 2016 error found in the figure of force diagram in the inclined surface.

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