

MISCONCEPTION ANALYSIS IN THE TEACHING BOOK OF HIGH SCHOOL PHYSICS AND EDUPARK MIFAN WATERPARK AND GEOPARK NGARAI SIANOK IN DYNAMIC FLUID MATERIAL

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ABSTRACT

The cause of errors and misconceptions experienced by some students and students is the large number of literature or books that describe the concept inappropriately. Writing difficult equations is also a factor in students' misunderstanding. So, misconceptions must be detected as soon as possible, especially in one of the causes, namely textbooks. This study aims to determine whether there are misconceptions in high school physics textbooks and physics edupark textbooks for class XI dynamic fluid material and to find out whether there are indications of other information that have the potential to cause misconceptions in textbooks. This research was a qualitative descriptive study that provides an interpretation of the data obtained rationally and objectively. In this study, data collection techniques were carried out by literature study and interviews with a team of physicists. The data source of this research was the physics textbook of Class XI high school by Marthen Kanginan in 2016 and the edupark physics textbook, while the data was the physics concept on dynamic fluid material. Credibility and triangulation techniques were used to determine the validity / validity of the data. Based on data analysis, conclusions can be drawn. Namely, there were misconceptions in book 2, while books 1 and 3 did not have any. Apart from misconceptions, the results of identification of other information were found, namely incomplete concepts, concepts that allow misconceptions, improving images, improving formulation writing, improving sentence writing, improving notation writing. The three books studied had the same findings of other information that led to misconceptions, namely on average there were 1 improvements for each indication found.

Keywords : teaching book, misconception, edupark, dinamic fluid



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I. INTRODUCTION

The development of all aspects of life is very fast in the era of the industrial revolution 4.0. With advances in information and communication technology it is easier to access information in various fields and in different languages. Information about many things including science, technology and art can be obtained easily anytime and anywhere. In line with this, the Ministry of Education and Culture updated the curriculum from KTSP to the 2013 curriculum, to adapt to the times and dynamic science.

The implementation of the 2013 curriculum is expected to produce graduates who are required to master competencies in the era of the industrial revolution 4.0, namely the ability to think critically (high order thinking), problem solving (problem solving), collaboration and creativity, as well as literacy, then able to take advantage of technology. Learning curriculum 2013 which aims to motivate students to have the ability to observe, ask, reason and be able to present (communicate) what is obtained after learning. This goal is a form of scientific learning that is applied in the 2013 curriculum to produce graduates who can master competencies in the current era[1].

Scientific learning is closely related to physics lessons, because physics learns about physical matter, facts, and concepts as well as branches of science. Physics lessons are part of science, not only a collection of knowledge in the form of facts, concepts, or principles, but also a learning that provides students with direct knowledge and experience of the surrounding environment. The goal of learning physics as stated in the 2013 curriculum framework is to master the concepts and principles and self-confidence as a provision to continue education at a higher level and develop science and technology [2].

In realizing the goals of the 2013 curriculum, especially in learning physics, there are several things that influence it, one of which is the readiness of textbooks. Textbooks are a form of input in learning activities that determine success in achieving national education goals. Textbooks are mandatory references used in learning in schools. Textbooks are the main learning resource for achieving basic competencies (KD) and core competencies (KI) based on Government Regulation Number 32 Article 1 Paragraph 23 of 2013 concerning educational standards.

The presentation of textbook material based on KD and KI aims so that students are able to learn independently without depending on the teacher. Textbooks must be of good quality because they are an important component in learning. Therefore, the availability of good textbooks will affect student learning outcomes. However, in fact the availability of good textbooks has not been fulfilled, because textbooks are not free from errors, writing, content, pictures, information and mistakes.

Textbooks are the work and results of a human's ideas and are not perfect works. A mistake cannot be separated from a textbook, but these mistakes are normal. The efforts to correct mistakes must be continuously strived to be eliminated and avoided as small as possible. Forms of errors that must be eliminated are misconceptions and other indications that give rise to misconceptions [3].

Misconception is a state of understanding construction of something that is contrary to the conception of the experts in the field. This situation will become an obstacle to the formation of correct knowledge. Misconceptions often occur to students, which results in low understanding of a science. A naive view or idea, the wrong explanation or misrepresentation of the concept are a form of misconception.

Misinformation or material in textbooks is a source that can cause misconceptions for students. In addition, inaccurate writing and editing of textbooks is also the cause of students' misunderstanding of concepts. Misconception of physics is a term which states that the conceptions owned by students are not precise and different from that of physicists. A concept is an idea or a group of facts / information that has meaning. The concept is described in a thought, idea or an understanding. A person is said to already have a concept when he has a clear understanding and is in accordance with the real meaning [5].

Misconception and indication of error can occur in a book. In a physics textbook contains many concepts, definitions, mathematical formulations, the rules for writing a symbol, quantities, units, pictures, graphs and diagrams which are very prone to errors which will potentially lead to misconceptions. Besides that, it can also be caused by language that is difficult to understand or the language level is too high, even if there is a wrong or incorrect explanation [4]. Therefore, a teacher is required to think selectively and critically in the selection of textbooks that will be used in learning. Textbooks must be in accordance with the competency standards (SK), KI and KD that you want to achieve and especially not contain misconceptions.

The form of government attention to textbooks is the existence of the National Education Standards Agency (BSNP) which assesses the feasibility of a book as a learning textbook. The feasibility of textbooks and their assessment is based on the Regulation of the Minister of National Education Number 22 Article 1 Paragraph 23 of 2007 concerning the determination of textbooks that meet the eligibility requirements for use in learning activities. However, in reality, the assessment and selection of textbooks by BSNP has not guaranteed that the book does not contain misconceptions. Some books have misconceptions in them. A study found that there were misconceptions in physics material in five science books that had been selected for quality and feasibility by BSNP [7].

Several studies have also been carried out, with the high school physics textbook I Class X written by Purwoko and Fendi as the source of research data by Desy and also a similar research conducted by Hasan Khoiri which identified misconceptions in high school physics textbook for Straight Motion Kinematics concept [5]. The results of these two studies still show misconceptions and other indications of inappropriate information in textbooks.

Based on some of these studies, it shows that misconceptions are still found in textbooks used by teachers or students even though there has been an assessment by BSNP. The reality in the field also shows that there are problems with textbooks. This was based on interviews with teachers and questionnaires to students. Interviews and questionnaires conducted with teachers and students aimed to find out their responses to textbooks used in the learning process at school. The results showed a negative response of 71.20% of students' assessments of textbooks.

From interviews and questionnaires to textbooks that have been responded to by teachers and students, the following conclusions are obtained:

1. There is no teacher reference in choosing textbooks based on misconceptions. The teacher argues that there are problems with misconceptions in textbooks
2. The teacher's efforts to overcome misconceptions in textbooks do not exist, teachers only look for other references, such as university books to find out the correct concept. Teachers are very supportive if there are attempts to analyze misconceptions in textbooks.
3. Students / students like physics lessons and physics lessons are very related to their life. However, most students do not understand the material in textbooks. Writing formulas, pictures, schemes, tables, illustrations and sample questions is mostly poorly understood by students and does not support students in understanding and motivating them to learn.
4. Some students responded that the concepts in textbooks sometimes did not match the concepts they had learned.

The cause of errors and misconceptions experienced by some students and students is the number of literature or books that describe the concept inappropriately. Writing difficult equations is also a factor in students' misunderstanding. Paying attention to a textbook that students use is important for teachers. Because, if students experience misconceptions, it will hinder the process of receiving new knowledge and affect the learning process. So. Misconceptions must be detected as soon as possible, especially in one of the contributing factors, namely textbooks.

From some of the data that has been obtained, it shows that there are conceptual problems in textbooks, especially regarding misconceptions. Thus, the existence of problems in textbooks is a strong reason to analyze and find errors, especially conceptual problems and other indications of errors in books. Research to reveal misconceptions or identify misconceptions in textbooks really needs to be done and also research on the identification of misconceptions in science books, especially physics textbooks, is still a little done. By conducting a concept analysis of the book will be a solution to overcome existing problems.

Textbooks that will be used as a source of research data are textbooks that are widely used in the learning process in schools. Based on a survey conducted, the book that is widely used in West Sumatra for class XI is the 2016 High School Physics Book by Marthen Kanginan [6]. The book has never been analyzed conceptual problems in it, because of that the concepts contained in it need to be evaluated for the correctness of the concept and may lead to misconceptions.

EduPark textbooks are also used as a source of research data. EduPark is an innovative tourist or recreational place, both natural and artificial, that can carry out learning so that activities feel more enjoyable. In addition to being a place of education, EduPark also functions as a tourist spot. Physics EduPark textbooks use nature and the environment as learning resources, thus giving a sensation of novelty and freshness for teachers and students in learning [7]. EduPark textbooks contain a scientific approach as well as activity-based books with the EduPark environment taken as topics, these 2 things are factors that must be owned by textbooks according to the demands of the 2013 curriculum.

EduPark textbooks in their development go through various stages, in these stages how the validity of the EduPark book is assessed, but in the instrument sheet the validity of the textbook is not too detailed and descriptions of the assessment of concepts. Because there are many aspects and other indicators that must be validated, it is necessary to evaluate the assessment, especially regarding the concepts in textbooks. Thus, this research is a part of further validation to analyze and assess in detail the correctness of concepts in textbooks.

The importance of analyzing misconceptions on textbooks, to correct and correct material, pictures and other information that is not correct in the book is renewed into correct concepts and materials. So that it makes understanding the concept later without a problem and can minimize the emergence of misconceptions and guarantee the quality of the book. Thus a research will be conducted on "Analysis of Misconceptions in High School Physics Textbooks and EduPark Physics Textbooks for Class XI Dynamic Fluid Materials".

II. METHOD

The research was conducted in a qualitative descriptive manner. Descriptive research is the description of an event or phenomenon so that it can explain an event as it is. While qualitative research is a research activity and procedure without the use of a static analysis or some other quantization method. The research objective descriptively will show an interpretation of data that has been collected objectively and logically. Furthermore, it provides an overview of the relationship of a data with other data that has been studied by describing the events / phenomena that occur in a more concrete and detailed manner [8].

This study uses purposive sampling technique in determining data sources. Purposive sampling technique is a technique of determining data that is based on certain objectives and considerations. Data is a collection of information about an object in the form of writing, images, recordings and others. While the data source is a

material for consideration in data collection methods and is also related to the quality of the research conducted [16].

The data sources of this research are the physics textbook of Class XI high school by Marthen Kanginan in 2016 and the physics edupark textbook, namely the physics edupark textbook Mifan Waterpark Padang Panjang, the physics edupark textbook based on the Sianok Ngarai Geopark. The data used in this research is the concept of dynamic fluid material in the three textbooks. This selection is because there is no research in West Sumatra that analyzes the problem of misconceptions in dynamic fluid material in semester 1 of class XI. In addition, dynamic fluid material is very much found in the environment and is also the most integrated topic in the development of edupark textbooks.

Another consideration for analyzing dynamic fluid material is research that shows misconceptions. Several studies in particular reveal that there are still many misconceptions about fluid mechanics. These misconceptions are caused by non-objective and rational ideas and wrong intuition. The form of misconception about dynamic fluids is that most students think that the greater the cross-sectional area of a flat pipe, the greater the fluid velocity in the pipe. Students also assume that the discharge value is not the same for each point on the horizontal pipe which has a different cross-sectional area.

Concepts regarding applications such as aircraft lift also experience misconceptions. Students understand that the pressure and velocity under the wing of an airplane must be large in order to lift the airplane upward. Some of these findings indicate that students' abilities need to be improved. Research on students' understanding and mastery of concepts in several schools about dynamic fluids. Based on the results, it was found that the highest mastery of students in schools was only 31% and the lowest mastery of concepts in schools was 24%. The rest of the students were classified as misconceptions, did not understand the concept, understood part of the concept with a percentage.

A data collection activity is an activity to obtain research data. The data will be used and processed and then presented according to the issues discussed. The data collection stage in this study used literature study and interviews with a team of experts. Literature study by collecting literature according to the topics discussed. Then validated or adjusted also with the views of experts in accordance with the field of physics, namely interviews with a team of experts.

In this study, a concept comparison sheet instrument was used and the results of the validation of findings in the book were used. The instrument sheet was validated by a team of experts. Collecting data by filling in concepts from textbooks and concepts from literature studies and a team of experts. The results of the concept analysis and suggestions or input from the expert team with it will show errors and misconceptions in the book being studied.

In a valid data study is the advantage of a study. The validity of a data can be obtained using a technique. The use of a technique will make data more proven for its authenticity and validity. A data that is tested through a validation aims to obtain invalid data (disability) [13]. The following techniques are used to obtain valid data: **Credibility**: Credibility is an activity that requires persistence and consistency in the observation process. It can also be interpreted as an attempt to consistently seek an interpretation through various ways with a connection to a constant analysis process. The degree of trust (Credibility) functions so that the level of confidence achieved from the data that has been obtained is truly accurate. Through accuracy, correctness and validity (valid) data obtained from the results of the analysis since the beginning of the study will determine the fidelity and accuracy of the research results to match the focus of the matter. **Triangulation**: Triangulation is used to obtain a more precise, accurate and credible interpretation of data. Triangulation is a data validity checking technique that utilizes things other than the data for checking and for comparing data. Thus, triangulation is an activity of checking data through various sources through various means, times and conditions but still in accordance with the focus of the problem [10].

Qualitative descriptive analysis is the analysis used in this study. While the model is data analysis according to Miles and Huberman. In this study, data collection was carried out in various ways, such as interviews, observations, library studies or document studies. Therefore, these data must be analyzed or processed before the data is used [10].



Fig 1. Components in Data Analysis (Interactive Model)

III. RESULTS AND DISCUSSION

The data obtained in this study are comparisons of equations, concepts, and images on dynamic fluid material in textbooks and reference books of universities and a team of experts. Through the analysis of the comparative data, we can see the concept and indication of other information that give rise to misconceptions. The following textbooks were analyzed in this study:

1. Textbook of High School Physics class XI based on the 2013 2016 curriculum with author Marthen Kanginan publisher Erlangga, hereinafter referred to as Book 1.
2. The Edupark Mifan Waterpark Padang Panjang Physics Textbook in 2019 with the author Dewi Puspa Sari, hereinafter referred to as Book 2.
3. Edupark Ngarai Sianok Physics Textbook 2019 with the author Wenda Emafri, hereinafter referred to as Book 3.

The results of literature study on the 2017 Ministry of Education and Culture Syllabus on Dynamic Fluid material in semester 1 and various kinds of literature and books both high school and university levels. Obtained the number of concepts in dynamic fluid material are 7 main concepts that must be studied. Of the 4 main subjects that students must understand, there are several important concepts, namely ideal fluid properties, flow lines, discharge, the principle of continuity, the principle of bernouli, Toricelli theorem, and application of the principle of continuity and flow in everyday life.

The data analyzed in this study include how the conceptualization, systematic writing of formulas, symbols, units and the accuracy of the presentation of an image. The use of a reference book, namely a university level textbook, such as by Giancoli or Tipler aims to obtain an accurate comparison of the data. The description of a concept or writing formulas, notations, units, sentence structure and images obtained in textbooks compared to university books, namely fiber reference books are analyzed and then discussed through shrinkage of the researchers, then validated by a team of experts to test their validity.

In a research, there must be a weakness, including in this study. However, efforts to overcome it need to be done. Weaknesses in analyzing need to be minimized with a high degree of accuracy and a good understanding of science. Both of these things are to avoid mistakes in determining a misconception or other indications that cause misconception. Based on this, the data collected needs to be validated to obtain valid data. Apart from validating the data to the validator who is also a team of experts, an interview was conducted first. Interviews were conducted by asking important points which were then responded to by a team of experts, then concluded the overall responses and obtained the research results. Following are the results of the analysis related to misconceptions in textbooks.

Table 1. Findings of Misconceptions on Dynamic Fluid Material in the Textbook studied

Textbook	Number of concepts according to the syllabus	Misconception	
		Total	Percentage
Book 1	7	0	0
Book 2	7	1	14.3%
Book 3	7	0	0

In the Physics Textbook, besides analyzing misconceptions, other information that has the potential to cause misconceptions is also identified, including: Incomplete concepts (IC), concepts that allow misconceptions (CM), improvements in image presentation (IWI), formulation (IFW), sentences (ISW), and notation (INW). Based on the data obtained and supported by the advice and input of the expert team, other indications were found that could lead to misconceptions. The findings of the identification of other information on each book are in table 2 below.

Table 2. Findings Indications of Other Information That Cause Misconceptions of Dynamic Fluid Material in the Textbook studied.

Textbooks	Total					
	IC	CM	IWI	IFW	ISW	INW
Book 1	6	3	6	1	3	1
Book 2	7	0	7	4	2	1
Book 3	4	1	5	2	3	1

Based on the results of the analysis supported by literature studies and interviews by a team of physicists, a misconception of Dynamic Fluid material was found in Book 2. One misconception found was about the concept of the principle of continuity, namely at the stages of proving the continuity equation formulation. In book 2, a concept is explained, which should be known after proving the continuity equation. The statement regarding the concept of equal discharge to prove the continuity equation is a false and incorrect explanation

Based on literature study and a team of experts, it is known that with the equation of the principle of continuity an interpretation will be obtained, namely the discharge along the flow even though different cross-sections remain the same. The form of the statement in the book that the discharge in the first section is the same as the second section to formulate the principle of continuity is a misconception. This concept shows that there is an incorrect relationship between the concepts. Incomplete explanation of concepts, misrepresentation of concepts, improper use of concepts, and improper hierarchical explanation of the relationship between concepts [11]. So, it can be concluded that the statement in the book under study is a concept that is not in accordance with the concept recognized by the experts.

Some students misunderstood the concept a lot and ended up experiencing misconceptions, especially in the relationship between speed and different cross-sectional areas. The explanation in textbooks can cause misconceptions of students as one of the textbook users, because the explanation is not right. Learning should understand the theory correctly about the concept, from that misconceptions or misconceptions need to be considered. Thus, it is necessary to correct misconceptions and need to be seen carefully, both by students as prospective teachers and physicists to the government. The work of all elements will be important in compiling a standard textbook. The concepts contained in a textbook must be correct and valid and must be in accordance with the concepts understood by experts [12].

The concept that allows misconceptions to occur in the elaboration of one of the books 1 on the derivation of the continuity principle. There is a statement that equates the mass which is incoherent with the previous description, because what has been previously described the description of volume is not mass. The explanation should match the previous information and the explanation after it. Whereas in book 2 studied there is no concept that allows misconceptions to be supported based on literature study and interviews with a team of experts.

In Book 3, there is 1 concept that allows misconceptions to occur in its translation. Statements in book 3 regarding assumptions or preliminary reviews in deriving equations should be emphasized more. Namely whether it is viewed in a steady manner or as seen that the fluid is in-compressible. Such assumptions or preliminary reviews must be definite and so as not to cause double understanding. This emphasis shows that the equation to be obtained is based on the reviews or initial assumptions given. The reference book that is studied always emphasizes the initial assumptions before proving the equation. Incomplete explanations can lead to big misconceptions, especially when students face physics problems that are broader and deeper. Wholeness, unity and linkage of sentences in a paragraph that will form an idea are important things to describe something.

For the improvement of the writing of the formulation of Book 1 and Book 3, it has been improved equally. Meanwhile, in Book 2 there are three improvements to the writing of the formulation. Most of the errors in writing the formulations of the three books lie in the incomplete formulations, so that the formulations must be described in more detail and precisely. Based on the comparison of concepts between textbooks and university reference books as well as interviews by a team of experts, the elaboration of the formulas in textbooks needs to be completed. Because, if the book contains only the final formula without an explanation of the process to get it, it will make students less interested in learning physics.

One form of improvement in writing the formulation is in Book 3 about the equation for the horizontal distance filled with fluid in the Toricelli theorem. The description of formulas in textbooks needs to be completed. Because book 3 only states the formula $x = vt$, it should be completed so that the final result is obtained $x = \sqrt{2gh}\sqrt{2h_2/g}$, the description should be formulated correctly, namely the horizontal distance

where the liquid falls on the floor against the vessel wall is. With $v = \sqrt{2gh}$. The time it takes for the water to reach the ground is obtained through the concept of free falling objects, namely $y = y_0 + v_{y0}t - \frac{1}{2}gt^2$.

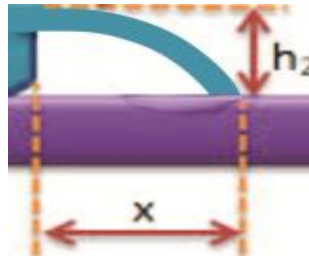


Fig 2. Schematic of the jet of water

With is the height of the tube from the ground floor to the leakage hole ($y = h_2$) based on Figure 1. If the leakage point is the origin and the downward axis is in the positive direction (if it is positive downward the minus sign (-) in front changes to (+) plus) the result of the equation becomes $h_2 = h_0 + v_{h2}t + \frac{1}{2}gt^2$. It is assumed that the motion of water $t = 0$ begins at the point of origin (leakage hole) so that $h_0 = 0$ and $v_{h2} = 0$, obtained by the equation $h_2 = 0 + 0 + \frac{1}{2}gt^2$, $t = \sqrt{\frac{2h_2}{g}}$ are obtained.

The velocity on the x-axis is the velocity of water coming out of the leaky hole $x = \sqrt{2gh}$, so that the distance the water jet travels from the leaking hole ($x = vt$) is $x = \sqrt{2gh} \cdot \sqrt{2h_2/g}$ so $x = 2\sqrt{hh_2}$ is obtained.

Improvements to images in textbooks under study, for example in Book 1 about Venturimeter images, namely:

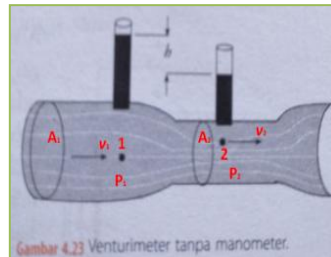


Fig 3. Venturimeter

Based on Figure 3 above, it can be seen that the description of the quantity is incomplete such as fluid velocity, cross-sectional area and others and is corrected by adding information to the red word. The emphasis and accuracy of the image need to be considered, because it is easy for students to understand. The arrangement of pictures or the incomplete information on the pictures can confuse students and lead to misconceptions. As with Books 2 and 3, there is still a lack of information in the pictures.

Composers of a book containing learning materials must pay attention to linguistic elements related to the legibility aspect. Reading is related to difficulty or ease in understanding the discourse in it. Based on the research, it was found several sentences that had to be corrected, one of which was about the Toricelli theorem, the editorial of the sentences contained in the book was difficult to understand, especially in the redaction 'located at a distance (h) below the upper surface of the fluid in the tank'. And also the word "distance" in the textbook sentence was changed to the word "height" based on the advice of the expert team.

Language that is difficult to understand or inaccurate redaction of sentences will make it difficult for students to understand and need to simplify the explanation. If not corrected, written errors in the book will be digested by students and thus students will get misconceptions. The sentence used in explaining something must be an effective sentence. Besides that, what must also be considered is the simplicity of the sentence. The simpler the sentence, the higher the legibility. If the book uses sentences that are difficult and unfamiliar to students, the legibility will be low and difficult to understand.

The notation errors in books 1, 2 and 3 are the same, namely the inconsistency of writing quantity notation. One example in book 3 is about a tube illustration which uses the notation 'L' in the distance symbol in Figure 3, while a tube with a different cross-sectional area uses the notation 'x', both illustrations should be consistent with the notation.

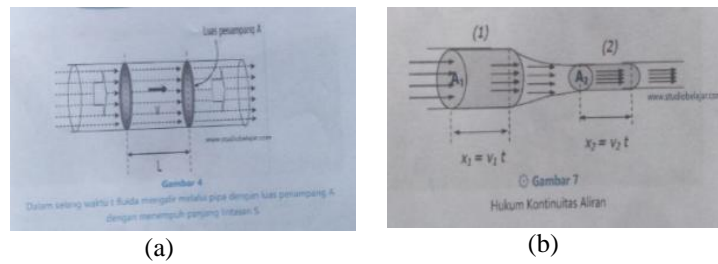


Fig. 4. a) Drawing for the concept of debit, b) drawing for the concept of the principle of continuity

The improvement of the notation was supported by interviews of an expert team and also in 3 university reference books consistent in the use of distance notations there were no differences or changes in notation. Writing inaccurate symbols or notations can potentially lead to misconceptions.

Based on the results of the analysis, it was found 1 misconception in book 2, while in other books there was no misconception found. Apart from misconceptions, there are also other indications that lead to misconceptions including: incomplete concepts, concepts that allow misconceptions, corrections to the writing of formulas, sentences, pictures and notations. The results of the analysis are in the following histogram:

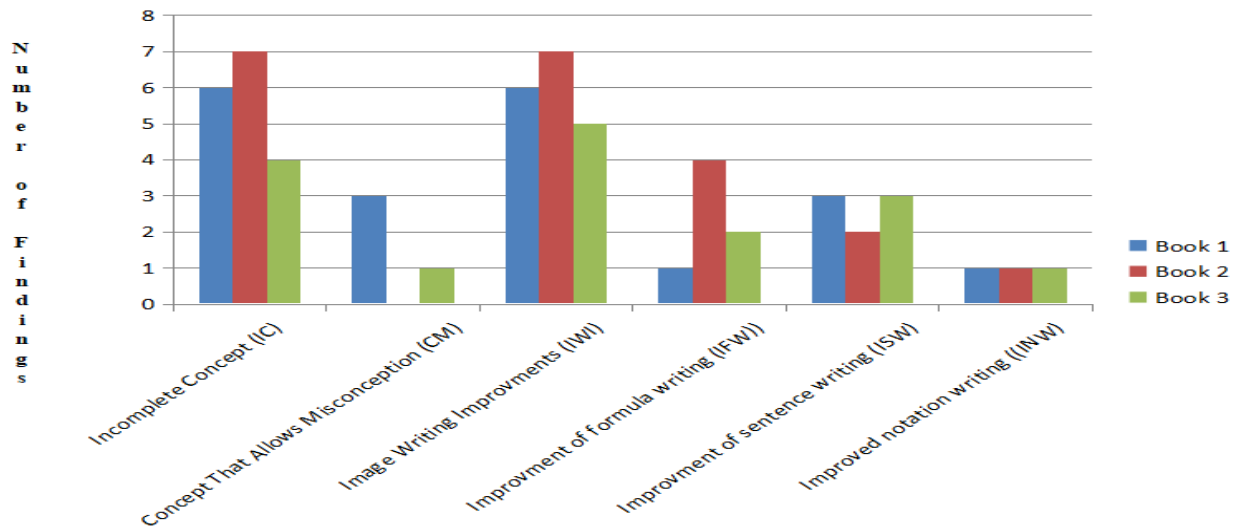


Fig. 5 Histogram Data Calculation Results Indication of Other Information that Cause Misconception in the book being studied.

Misconceptions and other information that have been found in this study need to be of concern to physics teachers. These results are of particular concern to teachers who will use these three textbooks as learning resources in schools. Thus, a physics teacher must be careful and selective in seeing and choosing which books to use. A teacher must pay attention to every concept, picture, graphic and how it is formulated in a textbook.

If there are errors or misconceptions in the book, immediately correct these mistakes and explain the correct concept to students. The results of the research can become a reference for teachers, book writers to really pay attention to the contents of the book, whether the material, pictures, graphics and others in the book are correct and valid. The contents of the book or material that contain the correct, valid and expert understanding will improve the quality of students' understanding of the subject of physics.

IV. CONCLUSION

The research results obtained can be concluded as follows:

1. There are misconceptions in book 2, while books 1 and 3 have no misconceptions.
2. The percentage of misconceptions in book 2 is 14.3%, while books 1 and 3 are 0% respectively.

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