

Analysis of Chemical Representation in Chemical Text Books Class XI High School in the Materials of Acid Base Solutions

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Abstract - Textbooks are reference books for certain subjects that are used by students and educators to facilitate the learning process. The material in the textbook must be in accordance with the competencies achieved in the curriculum and the material must also be accurate to avoid misconceptions. One way to assess textbooks is to analyze them. This study aims to describe the results of chemical representation analysis in chemistry textbooks of class XI SMA in the chapter material on acid-base solutions compared to standard textbooks. The data sources in this study are 2 chemical textbooks, namely Unggul Sudarmo (Book A) and written by Tine Maria Kuswati (Book B) and the standard textbook used as a reference is Chemistry the Molecular Nature of Matter by James E. Brady. Criteria that can be used to analyze chemical representations and the relationship between representations are the methods proposed by Gkitzia et al. (2010). This method has 5 criteria: (C1) Type of representation, (C2) Interpretation of surface features, (C3) Relatedness to text, (C4) Existence and properties of a caption, (C5) Degree of correlation between representations comprising a multiple one. The findings of this study indicate that the representation in Book A only fulfills 3 Gkitzia criteria, while Book B satisfies all Gkitzia criteria and corresponds to the representation that appears in the standard Brady textbook.

Keywords - Textbook, Chemical Representation, Acid-Base Solution.

I. INTRODUCTION

Textbooks are reference books for certain subjects that are used by students and educators to facilitate the learning process. A lesson textbook is declared feasible if it meets the standards of eligibility for content, language, presentation, and graphics that are assessed by the National Education Standards Agency and determined by a Ministerial Regulation. In the regulation there are no chemical textbooks that are suitable for use and in accordance with the 2013 Curriculum (Ministry of Education and Culture, 2015).

Chemistry is often considered difficult, one reason is that some concepts in chemistry are abstract, so that in studying chemistry high intellectual thinking is needed (Chittleborough, 2002: 1). Chemical concepts study several phenomena that cannot be directly observed, such as molecular structures and interactions between atoms, molecules and ions (Gilbert, et al., 2009: 233). Chemical

material contains concepts that are quite difficult for students to understand because they relate to three types of chemical representations. Through chemical representation, students can more easily learn chemistry especially for difficult material and misconceptions. Representation in the world of education is often used in textbooks (Gkitzia, et al., 2010: 6-7).

According to Chiu and Wu (2009: 251) chemical representation is a way to express phenomena, abstract concepts, ideas, and mechanism processes. Based on this, Johnstone (2000: 11) divides chemical representations into three levels, namely macroscopic level, submicroscopic level, and symbolic level. Macroscopic level is something real and visible, submicroscopic level is a level of representation that describes what happens at the molecular level and uses representations of theoretical models, such as particles that cannot be seen directly, while symbolic levels

are representations of reality in the form of images, symbol, or formula. So the use of all three chemical representations in textbooks is very helpful for students in understanding chemical concepts which are mostly abstract.

The difficulty of students learning concepts is not only caused by the learning process, but also can be influenced by the textbooks they use. In supporting the achievement of an optimal learning process, textbooks need to get the most attention, because not all textbooks can be accepted and understood by students. (Mulyoto, 2013: 58).

Chemical representation in the form of text and images in high school chemistry study textbooks can be one of the causes of these problems, so it is necessary to evaluate chemical representations in high school chemistry textbooks so that teachers can choose the right books for students so that possible misconceptions caused by textbooks can be minimized or even eliminated. (Farida, 2013: 216).

There are several theories put forward by experts to determine the quality of a textbook. The method or criteria that can be used to analyze chemical representations and the relationship between representations is the method proposed by Gkitzia et al. (2010), which each criterion consists of several typologies presented in Table 1.

Table 1. Criterion for evaluating the chemical representation and typology of each

Criterion	Typologi
C1: Type of representation	i. Macro ii. Submicro iii. Symbolic iv. Multiple v. Hybrid vi. Mixed
C2 : Interpretation of surface features	i. Explicit ii. Implicit iii. Ambiguous
C3 : Existence and properties of a caption	i. Completely related and linked ii. Completely related and unlinked iii. Partially related and liked iv. Partially related and unlinked v. Unrelated
C4 : Existence and properties of a caption	i. Existence of appropriate caption ii. Existence of problematic

	caption iii. No caption
C5 : Degree of correlation between representations comprising a multiple one	i. Sufficiently linked ii. Insufficiently linked iii. Unliked

II. METHODS

This type of research is descriptive research. According to Arikunto (2010: 33) descriptive research is research by making a description / picture / painting systematically, factually and actually dealing with the facts, nature and relationships between phenomena that are investigated as they are without treatment and manipulation of data and analyzing the facts that occur. The approach used is a qualitative approach; the data collected is in the form of words and does not use statistical analysis procedures (Moleong, 2006: 6)

Sources of data in this study are 2 Unggul Sudarmo class XI high school textbook textbooks (Book A) and written by Tine Maria Kuswati (Book B) and standard textbooks, Chemistry the Molecular Nature of Matter by James E. Brady, on solution material acid base.

The instrument used was a check-list of chemical representations in the textbook. The steps in collecting data in this study are to make a concept map of the material to be analyzed. Next, describe in general the chemical representation of each book. The chemical representation of each book is classified into photographs (scientists, laboratory equipment and glassware, and natural scenery), photos of chemical phenomena (chemical reactions and separation techniques), diagrams (chemical equations, concept maps, graphs, structural formulas of organic compounds), and images (images of chemical reactions, electrochemical cells, and arrangement of laboratory instruments) (Shehab, 2015: 5). Concentrate the results of representation analysis, by calculating the number of typologies that appear and dividing them by the total number of typologies multiplied by one hundred percent and determining the criteria. The results of the percentage of chemical representation are then compared between standard textbooks and sample textbooks in each chapter of the material so that it can be seen which books contain the most representative chemical representation in accordance with the book criteria and finally we can find the most qualified and most suitable books applied in chemistry learning so that it can improve student understanding.

III. RESULT AND DISCUSSION

1. General Description of Chemical Representation in Alkaline Acid Solution Materials

Table 2. General Description of Chemical Representations

Author of the book	Number of photos	Number of photos of chemical phenomena	Number of diagrams	Number of pictures	Number of representations
Brady	1	4	21	0	26
Buku A	2	0	13	0	15
Buku B	7	5	15	3	30

Based on Table 2, it is known that Brady's standard textbook and Book B as sample textbooks give rise to many chemical representations of acid-base solution material. The most representative representations of diagrams are in the form of reaction equations and mathematical equations.

2. Analysis of chemical representations

Table 3. Analysis of chemical representations

Criterion	Standard Textbook	Textbook Sample	
	Brady	Buku A	Buku B
C1. Type of representation			
i. Macro	3	0	6
ii. Submicro	1	0	0
iii. Symbolic	8	13	14
iv. Multiple	13	0	1
v. Hybrid	0	0	0
vi. Mixed	0	0	0
C2. Interpretation of surface features			
i. Explicit	15	13	18
ii. Implicit	10	0	3
iii. Ambiguous	0	0	0
C3. Existence and properties of a caption			
i. Completely related and linked	26	15	29
ii. Completely related and unlinked	0	0	0

iii. Partially related and linked	0	0	0
iv. Partially related and unlinked	0	0	0
v. Unrelated	0	0	0
C4. Existence and properties of a caption			
i. Existence of appropriate caption	26	15	29
ii. Existence of problematic caption	0	0	0
iii. No caption	0	0	0
C5. Degree of correlation between representations comprising a multiple one			
i. Sufficiently linked	11	0	0
ii. Insufficiently linked	1	0	0
iii. Unlinked			

Based on Table 3, it is known that Book B is only 3 Gkitzia criteria that are fulfilled, the analysis is symbolic (C1), explicit (C2), fully related and connected (C3), there is appropriate information (C4). In Book B all the Gkitzia criteria are met, the analysis is multiple (C1), explicit (C2), fully related and connected (C3), there is appropriate information (C4) and sufficiently connected (C5).

Table 4. Comparison of Percentages of Chemical Representations

Criterion	Standard Textbook	Textbook Sample	
	Brady	Buku A	Buku B
C1. Type of representation			
i. Macro	12%	-	29%
ii. Submicro	4%	-	-
iii. Symbolic	32%	100%	66%
iv. Multiple	52%	-	5%
v. Hybrid	-	-	-
vi. Mixed	-	-	-
C2. Interpretation of surface features			
i. Explicit	60%	100%	86%
ii. Implicit			

iii. Ambiguous	40%	-	14%
	-	-	-
C3. Existence and properties of a caption			
i. Completely related and linked	100%	100%	100%
ii. Completely related and unlinked			
iii. Partially related and liked	-	-	-
iv. Partially related and unlinked	-	-	-
v. Unrelated	-	-	-
	-	-	-
C4. Existence and properties of a caption			
i. Existence of appropriate caption	100%	100%	100%
ii. Existence of problematic caption			
iii. No caption	-	-	-
	-	-	-
C5. Degree of correlation between representations comprising a multiple one			
i. Sufficiently linked	8%	-	100%
ii. Insufficiently linked	84%	-	-
iii. Unlinked	8%	-	-

In acid-base solution material, the representation in Book A only fulfills 3 Gkitzia criteria, while the standard Brady textbook meets 4 Gkitzia criteria. Book A only has a symbolic representation in explaining material concepts so that it is not in accordance with the representations that appear in Brady's standard textbook that has multiple representation types.

The chemical representation in Book B meets all Gkitzia criteria, when compared to standard textbooks. Book A has a chemical representation that corresponds to the representation that appears in the standard Brady textbook in explaining the concept of acid-base solutions.

The results of the analysis of each criterion indicate that textbooks only focus on the level of symbolic representation. The symbolic level is the most commonly used representation in all textbooks. In addition, the textbook does not reveal the equality of characteristics at different levels of representation. Symbolic representation in the form of chemical reaction equations in textbooks can be a link between macro and submicro representations. Symbolic representation provides a large role in studying chemistry especially as a facilitator of fast and effective communication, but not in providing understanding to students. There needs to be support from other representations so that the goals to be achieved can be recorded in the students' long-term memory well.

IV. CONCLUSIONS

From the analysis carried out it can be concluded that the representations that appear in Book B more than Book A and Book B give rise to representations that are in accordance with the standard criteria for book representation and have the same suitability of representation with standard text books.

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