

---

## Students' Understanding Based on Flow Map Structure in Chemical Bonding

**R. Usman Rery<sup>1</sup>, Jimmi Copriady, Masnaini Alimin<sup>2</sup>, Sri Wilda Albeta<sup>3</sup>**  
Chemistry Education, Faculty of teacher Training and Education, Universitas Riau  
[r.usman@lecturer.unri.ac.id](mailto:r.usman@lecturer.unri.ac.id)

**Abstract** Education has an important role in the effort to create quality human resources. Chemistry can be understood through three aspects of chemical representation, namely macroscopic, submicroscopic, and symbolic aspects. Therefore, the purpose of this study is to look at students' understanding of chemical bonds using the concept of flow maps based on the gender. The sample of this study was 171 high school students of the XII level in Pekanbaru. Data were analyzed using SPSS 21.0 by looking at the frequency of students in answering questions and outlining the answers. The results showed that students understanding are below the average based on the frequency of students in explaining and answering questions given. The results of the t test analysis showed that there was no significant difference in understanding of male and female but based on the results of mean showed that male had a high average value compared to female scores. The results of this study are expected to provide information for teachers to improve cognitive thinking and understanding of students and teachers are expected to develop various questions therefore students have a lot of experience in describing questions and understand well the concepts of chemical

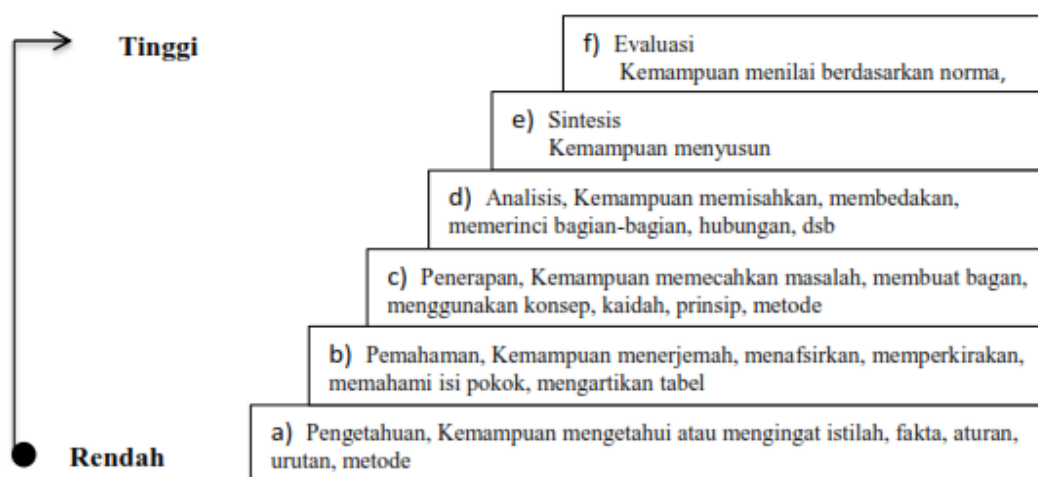
Keywords: Understanding, flowmap, chemical bounding

### 1. Introduction

The success of the learning process can be seen from the understanding of student concepts from before the learning process is carried out until after the learning process. Understanding the basic concepts at the beginning of learning will determine the success of student learning. Initial concepts that have been mastered will facilitate students in accepting new concepts given in the learning process. Topic of Chemistry in high school contains many concepts that are quite difficult to understand both by the teacher and students, because it involves chemical reactions and calculations and involves concepts that are abstract.

Chemistry can be understood through three aspects of chemical representation proposed by (Johnstone in Taber, 2013), namely the macroscopic, submicroscopic, and symbolic aspects. Macroscopic representations that can be observed directly, such as changes in color, temperature, pH of the solution, gas formation and sediment that can be observed when a chemical reaction takes place. Sub-microscopic representations are explanations at the particle level, namely the movement of atoms, molecules and ions (Chittleborough & Treagust, 2007). Symbolic representations are representations of chemical phenomena using chemical equations, chemical formulas, and symbols (Wu, and Soloway, 2001). Macroscopic, submicroscopic, and symbolic representations must be proportionally integrated in a learning to be able to fully understand the concept of chemistry.

The Cognitive Domain according to Taxonomy Bloom (Aunurrahman, 2009) consists of 6 types of behavior



**Picture 1.** Domain of Taxonomy Bloom

Techniques for organizing knowledge in the mind, and the existence of knowledge are very important for the formation of new knowledge. Learning involves an active process in which students construct meaning by connecting new ideas with their existing knowledge (Naylor & Keogh, 1999). Therefore, it is very important in the teaching and learning process to have a better understanding of "how to determine pre-existing knowledge" and "how we learn" to build new knowledge.

There are several misconceptions found in students in learning chemistry. As in the topic of chemical bonds, every concept in a chemical bond is a concept that is interrelated with each other, if there is an error in the concept of chemical bonds, then students experience concept errors in understanding the next concept, such as: chemical equilibrium, thermodynamics, molecular structure and chemical reactions (Özmen, 2004). Interviews conducted with several teachers who teach chemistry can be concluded that among students' misconceptions in understanding chemistry is that "all molecules with symmetry will be non-polar". This misunderstanding should be corrected so it does not become an ongoing misunderstanding for students.

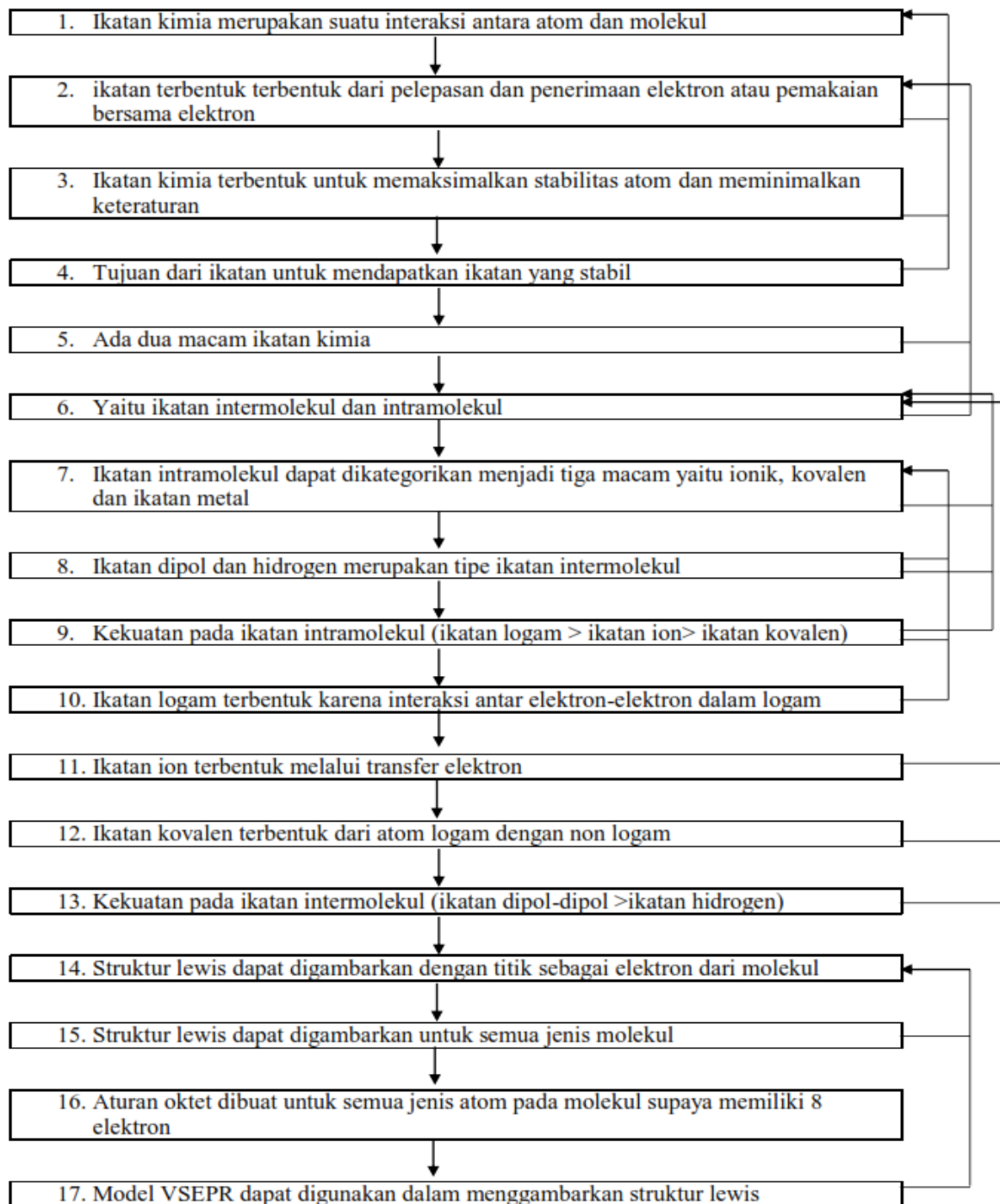
Flow maps can be used to conduct a series of content analysis of students' information processing operations. The information process, namely "how students organize their ideas" primarily concerns cognitive reasoning that accompanies each idea in the cognitive structure of students and can be categorized as: defining (concept definition), describing (imagining concepts or phenomena), comparing (comparing two or more concepts or situation) and concludes (explains what will happen with a certain circumference). Defining and describing modes, is "requires" low thinking ability, while comparing and inferring requires higher order in thinking ability (Tsai, 2001), such as critical thinking. The purpose of this study is to look at students' understanding of chemical bonds using the concept of flow maps based on the sexes of men and women.

## 2. Methodology

The design is the first thing a researcher must do before starting a research. The research design is described as a map or a blueprint for how the research will be carried out. This study uses a structured survey approach involving high school students in Pekanbaru City by using questions based on Chemistry bond topic based on the concept of Flow Mapping. The population and sample of this study were 171 high school students in Pekanbaru. The strength of a research lies in the research instruments and the way in which research data is collected. This research instrument uses understanding questions

in the form of analysis which is analyzed using the rubric of critical thinking (Siti Zubaidah, et al 2015)

Figure1. Explain the structure of the flow map that is the basis for researchers in making students' understanding questions. Flow map structure can explain the cognitive level of students in understanding the material provided in class. By following the flow map structure, the teacher can see the limits of understanding students' concepts in a subject matter.



Picture2. Structure Of The Flow Map

### 3. Result and Discussion

This study aims to look at the level of critical thinking of students in understanding the concept of chemical bonding material taught in high schools in Pekanbaru. Table 1 shows the sample profile of 70 (40.9%) male students and 101 (59.1%) female students from three high schools in Pekanbaru

**Tabel 1.** Profil of sample demography

<b>Demografi</b>	<b>Frequency</b>	<b>Percent</b>
Male	70	40.9
Female	101	59.1
Total	171	100.0

Descriptive analysis is carried out to see the level of student understanding of the material learned in class X which is about chemical bonds. The following describes several stages of student understanding based on the test questions that have been given.

#### 3.1. Student Understanding Based on Chemical Bonding concept

Based on table 2. shows that students have a good under-average understanding where students only understand the molecular formula with an average of 47.28 while the students' understanding on the topic of molecular shapes with an average of 44.62. the topic of chemical bonds by determining hybridization and geometric shapes has the highest average value of 49.98. overall the average understanding of students in the subject matter of chemistry both men and women are at a low stage with an average of 47.28.

<b>topic</b>	<b>Mean</b>	<b>Std deviasi</b>
molecular bonding formula	47.28	11.19
the shape of the bonding molecule	44.61	10.79
determine hybridization and geometric shapes	49.98	11.63
Overall understanding	47.28	17.07

#### 3.2. Difference in Understanding of Molecular Bond Formulas by Gender

Based on table 3 min understanding of men 49.78 with deviation standard 12.16 while min understanding of chemical bonds of women 45.54 with a standard deviation of 16.88. This shows that there is a difference in understanding the concept of chemical bonds between men and women, with the value of min male students higher than min women. However, the results of the t-test statistical analysis found that the value of  $t = 1,605$ , with the significant value obtained was  $\text{sig} = 0.110$ . Because the significant value is greater than the alpha value specified  $p = 0.110 < 0.05$ , there is no significant difference in understanding the chemical bond concept of male and female students based on the concept of flow map structure

**Table 3.** T-Test analysis of students' understanding based on gender

Gender	N	Mean	Std. deviasi	t	Df	sig
Male	70	49.78	12.16	1.605	169	0.110
Female	101	45.54	16.88			

#### 4. Conclusion

Based on the results of the study it can be concluded that students' critical thinking to understand the concept of chemical bonds is still very low. This can be seen from the number of students who choose not to answer and or answer with the wrong answer.

#### Acknowledgement

Thanks to university of Riau and department of teacher of training and education that provide a fund for this paper project

#### References

- Anderson, O. R., & Demetrius, O. J. 1993. A flow map method of representing cognitive structure based on respondents' narrative using science content. *Journal of Research in Science Teaching*, 30, 953-969.
- Chittleborough, G. D. & Treagust D.F. 2007. The Modeling Ability of Non Major Chemistry Students and Their Understanding of the Submicroscopic Level. *Journal of Chemistry Education Research and Practice*, Vol. 8, No. 4, hh. 274 292.
- Johnstone A. H., .1991. Why is Science Difficult to Learn? Things are Seldom What They Seem, *Journal of Computer Assisted Learning* , Vol. 7, No. 2, hh. 75–83.
- Naylor, S., & Keogh, B. 1999. Constructivism in classroom: Theory into practice. *Journal of Science Teacher Education*, 10 (2), 93-106.
- Finken dan Ennis. 1993. *Illinois Critical Thinking Essay Test*. Illinois Critical Thinking Project. Departement of Educational Policy Studies University of Illinois. (online) (<http://www.criticalthinking.net/IllCTEssayTestFinken-Ennis12-1993LowR.pdf>), diakses tanggal 4 Maret 2018.
- Oskay, O. O., & Dincol, S. 2011. Enhancing prospective chemistry teachers' cognitive structures in the topics of bonding and hybridization by internet-assisted chemistry applications. *World Journal of Educational Technology*, 3 (2), 90-102.
- Özmen, Haluk. 2004. Some Student Misconception in Chemistry: A Literature Review of Chemical Bonding. *Journal of Science Education and Technology*. vol. 13 No. 2. Hal. 147-159.
- Siti Zubaidah, AD. Corebima, Mistianah, 2015. Asesmen Berpikir Kritis Terintegrasi Tes Essay. *Symposium on biologi education*. Hal. 200-213
- Taber, K.S. 2013. Revisiting the Chemistry Triplet: Drawing Upon the Nature of Chemical Knowledge and the Psychology of Learning to Inform Chemistry Education. *Journal of Chemistry Education Research and Practice*, Vol. 14, No. 7, hh. 156-168.
- Wu, H. K & Soloway, E. 2001. Promoting Conceptual Understanding of Chemical Representations: Students Use of a Visualization Tool in the Classroom. *Journal of Research in Science and Teaching*, Vol. 38, No. 7, hh. 821-84.