

## STUDENTS' CONCEPT UNDERSTANDING IN CHEMISTRY LEARNING USING MACROMEDIA FLASH BASED INQUIRY LEARNING

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### Abstract

This research aimed at describing the effectiveness of the macromedia flash based inquiry learning in improving students' concept understanding in chemistry learning. It was an experimental research with post-test only design. The population was the eleventh-grade science students of state high school 5 Yogyakarta, Indonesia. The sample in this research was taken by random sampling technique as many as two groups, namely the experimental group and control group. The students in the experimental group learned through the macromedia flash based inquiry learning, while students in the control group learned through the conventional learning. The data on the students' concept understanding were collected through the concept understanding test. The data were analyzed by using one-way ANOVA with SPSS version 23.0. The results showed that students who used macromedia flash based inquiry learning in the assessment process have increased concept understanding better than those used conventional learning (value of significant  $< 0.05$ ).

**Keywords:** concept understanding, guided inquiry, macromedia flash, chemistry learning

### INTRODUCTION

Education according to the national education system is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and country. Education has an important role in improving human resources (Republik Indonesia, 2003). However, the United Nations Development Program (UNDP) in the report of the 2016 Human Development Report noted that Indonesia's Human Development Index (HDI) in 2015 was ranked 113, down from 110 in 2014. The causes of low quality education in Indonesia include problems of effectiveness, efficiency, creativity and standardization of teaching / learning (Fauzi, 2017).

Good learning is learning that includes unlimited learning experiences, ideas and emotions interact with the classroom atmosphere (Joyce, Weil, & Calhoun, 2009: 6). Chemical learning is learning that develops the competencies of students in order to be able to explore and understand chemical concepts systematically through a deeper learning experience (Suyanti, 2010:175). Students are required to actively apply knowledge to self-development. Chemistry learning emphasizes that students learn actively and learning experience can directly improve understanding of concepts and process skills, so that students can meet the standards of graduate competence (Chairam, Klahan, & Coll, 2015). The results of several studies conducted on students in chemistry learning showed that the understanding of students' concepts was low as indicated by the test scores and low national examination scores; students are less enthusiastic and lack interest in learning; teacher-centred learning; and learning is unpleasant and boring, so chemistry is considered a difficult subject for students (Anisa & Yuliyanto, 2017; Jusniar, 2016; and Fakhurrrazi, Masykuri, & Sarwanto, 2017).

Learning models are conceptual frameworks that describe systematic procedures in organizing learning experiences to achieve learning goals (Joyce, Weil, & Calhoun, 2009: 30). Inquiry learning

model involves students actively in finding and discovering their knowledge. The role of educators in the inquiry learning model as a facilitator and guide the course of learning (Tatsuoka, Shigedomi, & Koga, 2015: 1526). Inquiry learning model based on the level of dominance of the role of teachers and students is grouped into 4 types, namely demonstration inquiry, structured inquiry, guided inquiry, and full inquiry (Llewellyn, 2007: 101). Differences in the level of inquiry based on the degree of dominance of teacher and student roles are shown in Table 1. In this study used a guided inquiry learning model. In guided inquiry learning the teacher provides a formulation of the problem of the investigation, and the students design an investigation procedure, conduct an investigation to test the problem of the investigation and produce an explanation. Inquiry learning is more successful if students have the opportunity to learn and practice designing experiments and recording data. The role of the teacher in this learning model is to direct students who need guidance in designing and implementing experiments (Banchi & Bell, 2008: 28). However, based on several research results, it is shown that in chemistry learning the use of learning models is less varied and the teacher as a source of knowledge (lack of references from other learning sources) (Anisa & Yuliyanto, 2017; Jusniar, 2016; and Fakhurrrazi, Masykuri, & Sarwanto, 2017).

Tabel 1: Level of Inquiry According to Llewellyn (2007)

	Demonstration Inquiry	Structured Inquiry	Guided Inquiry	Full Inquiry
Question	Teacher	Teacher	Teacher	Students
Procedure	Teacher	Teacher	Students	Students
Analysis	Teacher	Students	Students	Students

Chemical learning can achieve maximum results if there is media use in learning. One of the media used is computer-based media such as Macromedia Flash. Macromedia flash is the right media to display visualization of learning. Macromedia flash attracts students' attention, so students like chemistry lessons and understanding students' chemical concepts increases. Learning that uses computer media effectively helps students to understand chemical concepts that are abstract in nature and can minimize misunderstandings that may occur (Talib, Matthews, & Secombe, 2005). However, based on several research results, it is shown that in chemistry learning the use of media is not as optimal as the use of multimedia and laboratories (Anisa & Yuliyanto, 2017; Jusniar, 2016; and Fakhurrrazi, Masykuri, & Sarwanto, 2017). Teacher-centered learning activities, less varied, and less optimal use of media make students less developed understanding of concepts and various skills possessed by students (widjajanti, Rohaeti, Isana, 2010 and Sutarno, Setiawan, & Kaniawati, 2016). The cognitive process that rests on the ability to transfer and emphasizes schools and colleges is understanding. Students are said to understand if they can construct the meaning of learning messages. Learners understand when connecting new and old knowledge they have. Conceptual knowledge (knowledge that is more complex and organized) is the basis for understanding. One of the indicators of success in the learning process is understanding concepts. Understanding the concepts of students seen from the scores of learning outcomes obtained. Students who understand the concept of good learning generally have a high learning outcome score. Cognitive processes in understanding categories include interpreting, exemplifying, classifying, summarizing, concluding, comparing, and explaining (Anderson & Krathwohl, 2010: 105). However, based on the PAMER UN application (Operation of the Application for the Utilization of National Examination Results) the results of the high school national chemistry examination in 34 provinces in Indonesia in the 2016/2017 academic year show that the national average chemical value is 53.05. This shows that students' understanding of the chemical concepts is still low.

Chemical equilibrium material is one of the chemical materials that must be studied and mastered by students in class XI High School to achieve graduate competency standards that must be possessed by students (Presiden Republik Indonesia, 2016). However, based on research conducted by Indriani, Suryadharna, & Yahmin (2017), it shows that students' understanding of chemical equilibrium material is still low, this causes students to experience difficulties in understanding chemical material that requires knowledge of chemical equilibrium prerequisites. In addition, research conducted by

Haryani, Prasetya, & Saptarini (2014) shows that in chemical equilibrium materials, teachers experience difficulties in mastering concepts and prospective teachers have difficulty in teaching students.

This shows that media use has not been maximized and students' chemical concepts understanding is still poor. Therefore this research applies macromedia flash based inquiry learning in chemistry learning to improve students' concept understanding in chemical equilibrium material. This is the reason why this research was conducted.

## METHODS

### Research Design

This research used the experimental method with post-test only design. The form design is shown in Table 2 (Cresswell, 2012). The research was begun by developing the learning tools by referring to the 4D (Define, Design, Develop, and Disseminated) model of Thiagarajan, Semmel, & Semmel (1974). In the developing stage, the evaluation learning tools were used to conduct the experimental research.

Tabel 2: Research Design

Group	Treatment	Post-Test
Experiment	Inquiry Learning (macromedia flash)	students' concept understanding
Control	Conventional Learning	students' concept understanding

### Participants

The population of this research included the eleventh-grade science students of state high school 5 Yogyakarta, Indonesia. The sample was taken by random sampling technique. The sample included 70 students; 34 students as the experimental group and 36 students as the control group. The students in the experimental group learned through the macromedia flash based inquiry learning, while students in the control group learned through the conventional learning. This research was conducted in the odd semester on academic year 2018/2019.

### Data Collection

The data of this research were the scores of the students' concept understanding, which were collected using the concept understanding test; 20 items of objective test. The concept understanding test was developed from cognitive processes in categories understanding. The seven items indicators assessed in this research is interpreting, modeling, classifying, summarizing, concluding, comparing, and explaining.

### Data Analysis

The data were analyzed using one-way ANOVA with the help of SPSS version 23.0. The inferential analysis was conducted with a 5% significance level. The normality of data distribution was tested using the Shapiro-Wilk Test. the homogeneity of variance data was tested using the Levene's Test of Equality of Error Variances.

## FINDINGS

Students' concept understanding in chemistry learning using macromedia flash based inquiry learning. The chemical material in macromedia flash is a chemical equilibrium material. Macromedia flash used in this research was made using the ispring suite 8 application. The display macromedia flash can be seen in Figure 1.

The concept understanding of the students who learned using the macromedia flash based inquiry learning were better than those obtained through the conventional learning. The average score of

concept understanding of the students who learned through the macromedia flash based inquiry learning was 76.47, while the student who learned through the conventional learning was 68.33. The distribution of the students' concept understanding is shown in Table 3. The post test scores in experiment group and control group are showed in Figure 2.

Table 3 The Distribution of Students' Concept Understanding

Group	Score of Concept Understanding			
	Sum of Samples (N)	Minimum	Maximum	Mean
Experiment	34	45	100	76.47
Control	36	40	100	68.33



Figure 1: The display macromedia flash

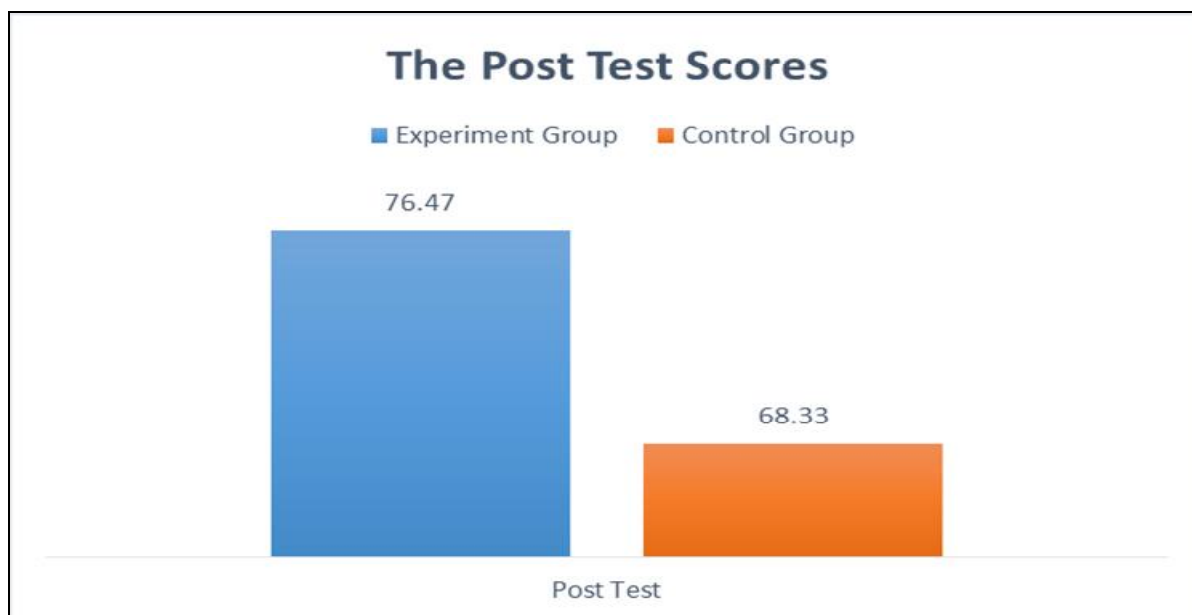


Figure 2: The Post test Scores in Treatment and Control Class Groups

The normality of the data distribution of the concept understanding of the students in the experimental group and control group were tested using the Shapiro-Wilk Test. The homogeneity of variance data was tested using the Levene's Test of Equality of Error Variance. The summary of the result of normality and homogeneity test are shown in Table 4.

Tabel 4: The Summary of The Result of Normality and Homogeneity

Group	Test of Normality			Test of Homogeneity	
	Shapiro-Wilk Statistic	df	Sig.	Levene Statistic	Sig.
Experiment	0.964	34	0.317	2.197	0.143
Control	0.954	36	0.145		

Based on Table 4, the data on the score of the students' concept understanding of the experimental group and control group are normally distributed. This is evidenced by the value of significant from normality test  $> 0.05$  which are equal to 0.317 (experiment group) and 0.145 (control group). Homogeneity of variance data is homogeneous. This is evidence by the value of significant from homogeneity test  $> 0.05$  which is equal to 0.143. Based on the characteristic of the data above, the data on score of the concept understanding can be analyzed using the one-way ANOVA. The summary of the result of analysis using the one-way ANOVA is shown in Table 5.

Tabel 5: The Summary of The Result of One-Way ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1157.815	1	1157.815	4.343	0.041
Within Groups	18126.471	68	266.566		
Total	19284.286	69			

Based on Table 5, the value of significant from the one-way ANOVA test is  $0.041 < 0.05$ , meaning that the concept understanding of the students who learned through the macromedia based inquiry learning are significant different from those of the students who learned through the conventional learning. The concept understanding of the students who learned through the macromedia flash

based inquiry learning are better than those of the students who learned through the conventional learning.

## DISCUSSION AND CONCLUSION

### Discussion

The research showed that the concept understanding of the student who learned through the macromedia flash based inquiry learning were better than those obtained by the students who learned through the conventional learning. Implementation of macromedia flash based inquiry learning has a significant effect on increasing concept understanding of students in chemistry learning. This is evidenced by the value of significant from the one-way ANOVA test  $< 0.05$  which is equal to 0.041, shown in Table 5. Besides, based on the analysis as presented in Table 3 shows the average of concept understanding in experiment group is higher than control group, that are 76.47 in experiment group and 68.33 in control group. The data obtained are normally distributed and homogeneous so that the data can be analyzed using one-way ANOVA with the help SPSS version 23.0, shown in Table 4. The display macromedia flash can be seen in Figure 1. Inquiry learning has a positive effect on concept understanding because the stages of inquiry based learning involve students actively and develop skills (Tatsuoka, Shigedomi, & Koga, 2015: 1526). In the process of learning the students must be empowered to be willing and able to do to enrich their learning experiences by increasing interaction with their environment both physical, social, and cultural environments (Budimansyah, 2003, 3). Chemistry learning emphasizes students' active learning and learning experience can directly improve understanding of concepts and process skills, so that students can meet graduate competency standards (Chairam, Klahan, & Coll, 2015).

Chemistry is the study of matter and its changes. Elements and compounds are substances that are involved in chemical changes (Chang & Overby, 2008: 2). Chemistry studies the building (structure) of matter and the changes experienced by matter in natural processes and in planned experiments (Keenan, Kleinfelter, & Wood, 1984: 2). Compared to other fields, chemistry often seems more difficult, at least at the basic level (Chang & Overby, 2008). Kean & Middlecamp (1985: 5-8) states that the difficulty in studying chemistry is related to the characteristics of chemistry itself, namely: Most concepts and theories in chemistry are abstract, chemistry is a form of simplification of the actual, nature sequential chemistry and its rapid development, chemistry is not just to solve problems, and so much material or material is studied. In addition students consider chemistry difficult subjects because of boring and unpleasant learning activities; students are less enthusiastic about participating in learning so the score of concept understanding is low (Anisa & Yuliyanto, 2017; Jusniar, 2016; and Fakhurrazi, Masykuri, & Sarwanto, 2017).

The use of macromedia flash in chemistry learning is able to attract and direct students' attention to concentrate on the content of the lesson relating to the visual meaning displayed (Arsyad, 2004). Macromedia flash attracts students' attention, so students like chemistry lessons and students' chemical concepts understandig. Learning that uses computer media effectively helps students to understand chemical concepts that are abstract in nature and can minimize misunderstandings that might occur (Talib, Matthews, & Secombe, 2005). Macromedia flash is a program for making animations, presentations, games and even learning devices with an attractive visual display (Wahyono, 2006). Macromedia flash is the right computer-based media to display abstract visualizations of chemical learning, so that learning activities achieve maximum results / learning objectives. Based on the results of several studies showing that the use of multimedia / macromedia flash can increase interest, activity, learning achievement, attitudes, and understanding students' concepts (Asiyah, Mulyani, & Nurhayati, 2013; Tatli & Ayas, 2013; and Wahyudin, Sutikno, & Isa, 2010).

Learning model is the stage of learning to achieve maximum goals (Gunter, Estes & Schwab, 1990: 67). The learning model is a conceptual and operational framework for learning that has a name, features logical sequences, settings, and culture (Presiden Republik Indonesia, 2014). Inquiry

learning models involve students actively in finding and discovering their knowledge while educators as facilitators and guide the course of learning. Inquiry learning is associated with environmental phenomena that are in accordance with their prior knowledge helping students build new knowledge. In finding and finding answers to a problem students are required to think critically and analytically (Tatsuoka, Shigedomi, & Koga, 2015: 1526). In addition, the inquiry learning model helps students develop intellectual discipline and skilled skills to improve questions and search answers that are hidden from the curiosity of students (Joyce, Weil, & Calhoun, 2009: 202).

Inquiry learning used in this study is guided inquiry learning. The guided inquiry learning model according to Llewellyn (2007: 106) is learning that begins with the teacher giving a question or problem that will be investigated and shows the material or material to be used. Next the students design and carry out the investigation procedure. Students then draw conclusions and arrange explanations of the data collected. The activities of the teacher and students in the guided inquiry learning are shown in Table 6. The stages of guided inquiry learning model are identification and determination of the scope of the problem, planning and predicting results, investigating data collection, interpreting data and developing conclusions, and reflecting. The stages of learning in inquiry learning provide an opportunity for students to learn actively in finding their knowledge (the teacher as a facilitator and overseeing the course of learning), looking for learning resources from various media, developing understanding of concepts, thinking critically, analytically, and process science skills (Chairam, Klahan, & Coll, 2015 and Tatsuoka, Shigedomi, & Koga, 2015: 1526).

Table 6: The activities of the teacher and students in the guided inquiry learning

Learning stages	Teacher Activities	Student Activities
Identification and determination of the scope of the problem	Asking problems to solve or questions to investigate	Defines the nature and parameters of the problem
Plan and predict results	<ul style="list-style-type: none"> <li>➤ Encourage students to design procedures or means to solve problems or answer questions asked</li> <li>➤ Encourage students to choose the right tools and materials needed</li> </ul>	<ul style="list-style-type: none"> <li>➤ Brainstorming about alternative procedures and problem solving solutions</li> <li>➤ Choose or design a problem solving strategy</li> <li>➤ Choose the tools and materials needed right</li> </ul>
Investigation for data collection	<ul style="list-style-type: none"> <li>➤ Guiding students in conducting investigations and encouraging individual responsibilities of group members</li> <li>➤ Directing students to utilize other sources of information for problem solving</li> </ul>	<ul style="list-style-type: none"> <li>➤ Implement plans to solve problems</li> <li>➤ Use science process skills to collect and analyze information</li> <li>➤ Observe, collect data, communicate, and work with members</li> </ul>
Interpret data and develop conclusions	<ul style="list-style-type: none"> <li>➤ Guide students to organize data</li> <li>➤ Guide students how to communicate their findings and explanations</li> </ul>	<ul style="list-style-type: none"> <li>➤ Make observational notes</li> <li>➤ Processing the collected data in the form of graphs and tables</li> <li>➤ Make patterns of relationships in the data</li> <li>➤ Draw conclusions and formulate explanations</li> <li>➤ Communicate the results of the investigation</li> </ul>
Feedback	<ul style="list-style-type: none"> <li>➤ Encourage students to think or reflect on the knowledge they have just discovered</li> </ul>	<ul style="list-style-type: none"> <li>➤ Evaluating the inquiry process that has been carried out</li> <li>➤ Asking new questions based on the data collected</li> </ul>

Based on the results of several studies on inquiry learning, it is shown that inquiry learning is better than conventional learning. The results of the application of inquiry learning are improving understanding of chemical concepts, science process skills, problem solving skills, building self-confidence, independence, increasing the depth of student knowledge and overcoming misunderstandings (Vilaro, Mackenzie, & Yeziarski, 2016: 206; Tatsuoka, Shigedomi, & Koga, 2015: 1526; Mistry, Fitzpatrick, & Gorman, 2016: 1091; King, Wang, Yeziarski, 2017: 158; Chairam, Klahan, & Coll, 2015: 937). The cognitive process that rests on the ability to transfer and emphasizes schools and colleges is understanding.

One of the indicators of success in the learning process is concepts understanding. Learners more easily solve problems faced in the learning process even in everyday life if they have a good concepts understanding, therefore concepts understanding needs to be developed. One of the goals in chemistry learning is to increase meaningful understanding in chemical concepts. Meaningful learning occurs when students integrate new concepts into their cognitive structure (Chairam, Klahan, & Coll, 2015). Ausubel (Hacieminoglu, 2016) states that integrating concepts continuously will help students gain meaningful learning. Students who are unable to integrate new concepts into their previous knowledge tend to use memorization and express their understanding with concept definitions as isolated facts. Students are said to understand if they can construct the meaning of learning messages, whether oral, written or graphic, delivered through teaching, books, or computer screens. Learners understand when connecting new and old knowledge they have. Cognitive processes in understanding categories include interpreting, modeling, classifying, summarizing, concluding, comparing, and explaining (Anderson & Krathwohl, 2010: 105).

Conventional Learning Models do not provide opportunities for students to be active in learning activities. The teacher as a source of knowledge and students only accept what the teacher says. In conventional learning students are less involved in discovering new concepts / knowledge, teacher-centered learning, students are not stimulated by their curiosity and the use of less optimal learning media such as multimedia and laboratory use. This causes the understanding of concepts and skills possessed by students to be less developed (Anisa & Yuliyanto, 2017; Jusniar, 2016; and Fakhrruzazi, Masykuri, & Sarwanto, 2017).

Although the concept understanding of students who learned through the macromedia flash based inquiry learning were better than those obtained by the student who learned through the conventional learning, the results were not optimal. This was caused by many obstacles in the implementation of the inquiry based learning. The obstacles found in the implementation of the macromedia flash based inquiry learning was difficulty in growing the positive habit of the students to be active, as the learning results from the learning experience before tend to make the students passive. The students must be habituated to follow inquiry learning so that they can develop concept understanding to the fullest.

### **Conclusion**

Based on the results of this research, it can be concluded that the concept understanding of the students who learned through the macromedia flash based inquiry learning were better than those obtained by the students who learned through the conventional learning. The average score of the concept understanding of the students who learned through the macromedia flash based inquiry learning and conventional learning were 76.47 and 68.33, respectively. Implementation macromedia flash based inquiry learning has a significant effect on increasing concept understanding of students in chemistry learning. This evidence by the value of significant from the one-way ANOVA test  $< 0.05$  which is equal to 0.041. The concept understanding developed at chemistry lesson and the topic of chemical equilibrium is interpreting, modeling, classifying, summarizing, concluding, comparing, and explaining.



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