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The Effect of the 8E Learning Cycle Model on Eleventh-Grade Students' Conceptual Understanding of Salt Hydrolysis

Elma Suryani^{1,*}, Maria Paristiowati², Dini Delfiana³

^{1,2,3}Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Jakarta, Jl. Rawamangun Muka, Rawamangun sub-district, Pulo Gadung district, East Jakarta City, Special Region of Jakarta 13320

Email: elmasuryani@unj.ac.id*

Abstract

Students' conceptual understanding remains low in chemistry, particularly in the topic of salt hydrolysis. This study aims to determine the effect of the 8E learning cycle model on the conceptual understanding of 11th-grade students in the subject of salt hydrolysis. This research is a quasi-experimental study with a non-equivalent pre-test/post-test control group design. Pre-test and post-test were administered to collect data on students' conceptual understanding. The sample consist of 68 students, including 34 students in the experimental class were taught using the 8E learning cycle model, and 34 students in the control class were taught using the 5M model. The result of N-gain of the experimental class was 0.642, while the control class had an average of 0.44. The average N-gain of both classes is medium category, although the N-gain of the experimental class was higher. Based on the Mann-Whitney U test, a significant difference was found between the post-test conceptual understanding results of the control class and the experimental class. Therefore, it can be concluded that the implementation of the 8E Learning Cycle has an impact on the conceptual understanding of the salt hydrolysis topic. These finding indicate that the 8E Learning Cycle is effective in improving students' conceptual understanding in the topic of salt hydrolysis.

Keywords: 8E Learning Cycle, Conceptual Understanding, salt hydrolysis

Introduction

The Merdeka Curriculum concept requires students to be independent (Manulu et al., 2022). One of the learning approaches that needs to be implemented in the independent learning curriculum is the student-centered learning method. The application of the student-centered method in education is closely related to conceptual understanding. Students are expected to be more active and independent in seeking various learning resources (Pertwi et al., 2022). According to Stojanovska et al. (2012), chemistry is a conceptual subject based on a number of abstract concepts, making it highly likely that students experience difficulties in understanding and explaining these concepts (Stojanovska et al., 2012). In general, chemistry topics are

related to the structure of matter, which is the reason for the difficulty in learning chemistry (Sirhan, 2007). The difficulties that arise in the implementation of chemistry learning are inseparable from the characteristics of chemistry learning, which tends to present material that is abstract and complex, thus requiring a deep understanding to learn it (Sari et al., 2015).

Based on the results of an interview with one of the chemistry subject teachers, the conceptual understanding of students has not been achieved among less active students. In addition, chemistry also observes the changes and interactions between particles that form the materials we encounter in our daily activities (Sofia & Wulandari, 2018). In material that requires calculations, there are sometimes obstacles related to mathematical concepts, for example, in calculating the pH of a solution, there are obstacles with logarithms. In addition, several research findings indicate that 11th-grade MIPA high school students still encounter conceptual errors related to salt hydrolysis.

The constructivist-based learning approach emphasizes the active role of students in constructing their own knowledge, creating a more interactive learning environment. The implementation of the 8E Learning Cycle is expected to enhance students' conceptual understanding, critical thinking skills, and learning motivation. Furthermore, based on previous research conducted by Rizal, M., et al (2022), the research results indicate a significant difference in concept understanding and misconceptions between the experimental class students and the control class students. The concept understanding of the experimental class was higher (43.62%) than that of the control class (28.95%), and the misconceptions in the experimental class were lower (40.76%) than those in the control class (47.81%). From this data, it can be concluded that the application of the 8E Learning Cycle model is more effective than the online expository model (conventional) in addressing misconceptions in buffer solution material (Rizal et al., 2022).

Method

The method used in this research is a quasi-experimental type quantitative method. The research design used is a pretest-posttest non-equivalent control group design. The experimental class was given the 8E Learning Cycle model, while the control class was not given the 8E Learning Cycle model but followed the teaching model used by the teacher in the control class, which was the 5M model. The pretest and posttest questions given each consisted of 30 questions or 15 pairs of two-tier multiple-choice questions that were selected based on the results of validity, reliability, discrimination power, and difficulty level tests. Based on the results of the validity test, 21 valid questions and 7 invalid questions were obtained. Meanwhile, in the reliability test based on calculations, an r value of 0.899 was obtained, which falls into the high category. The testing in this study uses non-parametric statistical analysis, so the hypothesis test used is the Mann-Whitney U test to determine whether there is a difference in the average conceptual understanding between the experimental group and the control group.

Results and Discussion

The Implementation of Learning Model

The research activities were conducted over 6 meetings on the topic of salt hydrolysis. The first meeting in the experimental and control classes involved working on a pretest to determine the initial abilities of the students before the treatment was given. In the control class, the 5M model is used, which consists of the observing stage, questioning stage, information gathering stage, information processing stage, and communicating stage. Meanwhile, in the experimental class, the Learning Cycle 8E model is used, which consists of eight stages or phases: engagement, exploration, E-search, elaborate, exchange, extend, evaluate, and explain. In the initial stage of the Learning Cycle 8E model, which is engagement, students analyze learning cases or each sub-chapter of the material.

The second stage is explore (exploration), where students respond to brief questions from the teacher regarding the case in the previous stage or engagement. According to Jumiati W, Martin (2021), seen from the exploration stage, which includes exemplifying, classifying, and drawing conclusions, these aspects fall into the exploration stage because the process of acquiring knowledge at this stage will form an

understanding of the material (Jumiati & Martini, 2021). The next stage is E-search or searching for references. At this stage, students are given the opportunity to search for information about salt hydrolysis and are allowed to use the internet to enhance their knowledge. Then in the elaborate stage, students watch a video presented by the teacher that contains the testing of salt compounds. In this stage, students analyze the video by combining their prior knowledge with the knowledge gained from the previous stages. In conceptual understanding, the aspects that are assessed are concluding and comparing (Jumiati & Martini, 2021). After the students watched the video, in the exchange stage of the second meeting, the students discussed in groups and created a report on the results of the experiment in the video in the form of a Student Worksheet. Meanwhile, in the third meeting, the students formed groups and the teacher presented hidden questions on nine cards. Then, the students, in groups, answered the questions by discussing the selected questions on the cards. At the exchange stage, students learn to express their opinions with reasoning and the ability to participate by listening to others' opinions. Next is the extend stage, where students expand their understanding of salt hydrolysis with explanations from the teacher. At this stage, students can integrate other concepts and broaden their understanding. At the evaluation stage of the second meeting, students work on evaluation questions in the form of multiple-choice exercises thru the Kahoot media. This stage focuses on gathering information about students' learning achievements and understanding. The students' learning outcomes will show the extent to which they understand the material that has been studied together. The final stage is explain, after completing the questions in the evaluate stage, students are given the opportunity to explain their answers. In the explain stage, the teacher acts as a facilitator who corrects any incorrect or misunderstood concepts.

In the control class, the 5M model is applied, which consists of the stages of observing, questioning, collecting information, processing information, and communicating. The first stage is observing, where students can watch a video shown by the teacher or images of phenomena related to the topic of salt hydrolysis. Next is the questioning stage, where students ask questions and respond to answers about the phenomena being discussed in relation to the topic of salt hydrolysis. Students can ask questions about information that has not been understood from what has been observed. In the third stage, which is gathering information, at this stage students listen to the teacher's explanation to expand the material. The management of information collected by students includes the addition of breadth and depth of understanding, as well as the search for solutions from various sources with differing or even conflicting opinions (Buloto, 2018). After collecting information, the next stage is processing the information. At this stage, students can work on the questions given by the teacher by relating them to the previous learning stages or by gathering information. The final stage is communicating, where students can present the results of the questions given, observations, or conclusions from the learning process. Then, in the sixth meeting, the researcher conducted a posttest aimed at measuring conceptual understanding after treatment or instruction was given in each class.

Students' Conceptual Understanding

Assessment of students' conceptual understanding is measured using a two-tier multiple choice diagnostic test instrument consisting of 15 pretest questions and 15 posttest questions. In each question, there are two levels: the answer and the reasoning behind the student's answer, with five assessment categories. According to Calik and Ayas (2005), the five categories are sound understanding (SU), partial understanding (PU), partial understanding with specific alternative conception (PS), specific alternative conception (SA), and no understanding (NU). Based on the pretest and posttest results in the experimental and control classes, the following data were obtained (Calik, 2005).

Table 1. Pre-test and Post-test Score

Group	Mean	SD	Median	Modus
Pre-test Experiment	66.90	7.65	68.67	69.33
Post-test Experiment	88.16	8.93	92	93.33
Pretest Control	68.98	9.02	69.33	68

Post-test Control	82.63	11.02	86	92
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The data in the table shows that the average pretest scores in the experimental class and the control class are not significantly different. Meanwhile, the average posttest score in the experimental class is higher than in the control class, with a score difference of 5.53. Based on the posttest results, the experimental class had an average score of 88.16 and the control class had an average score of 82.63. This difference in average scores indicates that the average ability of students in the experimental class is higher than in the control class.

From the assessment of the pretest and posttest in the experimental and control classes, which refer to the five categories of conceptual understanding, namely sound understanding (SU), partial understanding (PU), partial understanding with specific alternative conception (PS), specific alternative conception (SA), and no understanding (NU). In the five categories of conceptual understanding, the highest category is SU, which is sound understanding or comprehension when students answer the first and second tiers correctly and completely. In the experimental class, there was a change of 45.94% in the SU category or comprehension. Meanwhile, in the control class, there was a change of 32.00% in the SU category or comprehension. The results of this study support previous research conducted by Faudilla (2019), which showed that the application of the learning cycle model resulted in an improvement in students' conceptual understanding in each cycle conducted (Faudilla, 2019).

Furthermore, it can be seen based on the percentage changes in other aspects of conceptual understanding. Conceptual understanding is divided into seven aspects: interpreting, giving examples, classifying, summarizing, concluding, comparing, and explaining. In this study, the aspects with a high cognitive level are summarizing and comparing, which fall under the C4 cognitive level, while the lowest level is C2, which includes giving examples and explaining. Based on the data from the experimental class, the aspects of summarizing and comparing in the understanding category (SU) showed posttest changes of 27.94% and 23.53%, respectively. Meanwhile, for the control class, the aspects of summarizing and comparing in the understanding category (SU) showed changes of 22.06% and 20.59%, respectively. This indicates that the changes or increases in the understanding category from the pretest to the posttest in the experimental class for the aspects of summarizing and comparing were higher than in the control class. Based on the pretest and posttest results in the experimental and control classes, the gain scores can be calculated. Here is the table of the gain score.

Table 2. N-Gain Score

Group Test	Gain Score	N-Gain Score	Category
Experiment	21.25	0.642	Medium
Control	1.647	0.44	Medium

The N gain from the experimental class has an average of 0.642 and the control class has an average of 0.44. The average N gain of both classes falls into the same category, which is the medium category, although the N gain of the experimental class is larger.

Hypothesis Test Result

The Mann-Whitney U test is a two-sample independent test in nonparametric statistics that serves the same purpose as the t-test in parametric statistics, which is to determine whether two independent samples come from the same population. (Santoso, 2015). Here is Table 3 of the Mann-Whitney U test ranks.

Table 3. Ranks U Mann-Whitney Test

Group Test	N	Average	Sum of Range
Experiment	34	41.74	1419.00
Control	34	27.26	927.00

Based on Table 24, the average rank for the experimental class is 41.74, while the control class is 27.26. Meanwhile, the total rank obtained is 1419.00 for the experimental class and 927.00 for the control class.

Table 4. U Mann-Whitney Test Result

	Gain Score
U Man-Whitney	332.00
Z	-3.021
Asymp. Sig. (1-tailed)	0.0015

Based on the calculation results, the value of Asym. Sig (1-tailed) is 0.003. The value of Asymp. Sig (1-tailed) is less than 0.05 ($0.0015 < 0.05$). This means that H_0 is rejected and H_1 is accepted, so inferentially with the Mann-Whitney U Test, it can be said that there is a significant difference between the posttest results of conceptual understanding in the class taught with the Learning Cycle 8E and the posttest results of conceptual understanding in the class taught using the 5M model. Furthermore, the calculation results in an effect size of 0.366 with a medium effect category.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that the application of the 8E Learning Cycle model significantly improves students' conceptual understanding of salt hydrolysis material compared to the 5M learning model. This is evidenced by the higher average posttest score of the experimental class (88.16) compared to the control class (82.63), as well as the experimental class's N-gain value of 0.642, which is higher than the control class's 0.44, although both are in the moderate category.

The results of the Mann-Whitney U test showed a significant difference between the two groups (Asymp. Sig. = $0.0015 < 0.05$), thus the research hypothesis was accepted. In addition, the effect size value of 0.366 indicates that the application of the Learning Cycle 8E has a moderate impact on improving students' conceptual understanding. These findings indicate that the Learning Cycle 8E model can be an effective alternative learning method to help students build a better understanding of chemical concepts, especially on abstract materials such as salt hydrolysis. Future research is recommended to investigate the effectiveness of the 8E Learning Cycle Model in other chemistry topics and analyze its impact on students' 21st century skills.

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