Exploring Students’ Integrated Ability and Creativity: Using 7e Learning Cycle Model in Chemistry Learning

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Abstract. This research aims to determine the influence of students’ 7E learning cycle model towards students’ integrated ability (ability to think analytical-creative in science) and students’ creativity in chemistry material. Two classes had different treatments in which experimental class used 7E learning cycle model and control class used expository. Using cluster random sampling, 64 students were chosen as samples. The technique of data collection used three instruments. They were instrument used to see students’ integrated ability consisting five questions given in the end of the class, instrument to see students’ learning creativity using questionnaire and observation. To analyze the data, this research used MANOVA. The result revealed that there was influence of 7E learning cycle model towards students’ integrated ability and creativity. In summary, 7E learning cycle model students’ integrated ability and creativity.

Keyword: Students; Integrated ability; Creativity; 7e learning cycle model; Chemistry learning

1. Introduction
Chemistry is one of difficult subjects according to conceptual and curriculum in the school [1]. Wood added that chemistry is a difficult subject for many students for several reasons, and one of which is that the success of students especially upper level students depends on the information that they have learned in the previous lesson [2]. In fact, a basic understanding about chemistry and science is very important to live in technological era of society and is useful in dealing with problems in everyday life: health, energy, environment, and etc. [3]. The success of the subject and having good understanding chemical concept depends on how teacher creates learning media to be the one which has a quality. Quality learning has values which contain goals, process and achievement of standardized, effective and efficient criteria. Effective learning is implemented through interactive and interesting process [4]. Student is thus expected to be more active in learning chemistry. However, how students seem less active in learning causes low transfer of knowledge.

To achieve the goal of quality learning, teacher is one of facilitator who is required to have more creative in designing the learning. Since teacher is an important teacher in creating quality learning, the teacher is also required to make learning process more interesting. It will attract students to be more active and creative, so it will not create teacher-cantered learning in that students are able to think analytically and the integrated science process skills in understanding the materials will meet the goal of 2013 curriculum (K-13) implemented in Indonesia. However, Siswanto in [5] stated that students tend to depend on their teacher in understanding the lesson, so students may have low thinking skill and independence in learning process. Science process skills rarely occur in the learning for the problem is product-oriented, not process-oriented. Besides, students also lack of analytical thinking skills since they are not familiar with organizing and identifying a problem [6]. In addition,
the reason why teacher-centered learning still occurs is that students may have less creativity. Hence, teacher requires to facilitate creative learning for students [7]. Tanggard in [8] demonstrated that creativity is an important factor in formal and informal learning process. To achieve students’ creativity, two factors need to be paid attention: 1) the meaning of creativity for teacher and 2) concrete practice of students’ creativity in the classroom [3]. Cheung in [9] mentioned that in order to implement creative learning in the classroom, a teacher should be able to make students “shocked”, such as wearing a shirt written the materials to be delivered on it. However, in Indonesia particularly in public schools, creative learning is hard to implement. Therefore, teachers are able to maximize creative learning in the classroom and students do not understand the concept well. Understanding the concept well depends on learning process and learning model. As a matter of fact, teachers have not implemented yet a good learning model, so the learning cannot be optimal since many students get sleepy in the classroom [10]. Rohwat [11] expressed that the use of appropriate learning model to students and academic needs assists effective, interesting and educative teaching and learning activity. Therefore, to achieve learning goals, teachers need to prepare suitable learning model, approach or strategy.

To solve the problem above, Eisenkraft in [12] mentioned the active learning model able to be used is 7E Learning Cycle (elicit, engagement, exploration, explain, elaboration, evaluation, extend). The 7E Learning Cycle involves students to solve a problem through scientific method. The implementation of 7E Learning Cycle in the learning process enables students to search any information through their analytical thinking to solve their own problem independently and creatively and to get a knowledge through scientific process. This learning model is expected to give influential treatment to students’ integrated skill and creativity. This model is also able to train students’ integrated skill (analytical thinking skill and science process skill) particularly in buffer solution lesson.

Buffer is a solution whose pH value is relatively constant at adding a few acid and alkali and is relatively constant at adding a few water. Buffer usually contains a weak acid and alkali and its conjugation in almost the same concentration. Buffer has a major role in controlling the solubility of ions while maintaining pH value in biochemical and physiological process. Motivated from aforementioned explanation, this research determines the influence of students’ 7E learning cycle model towards students’ integrated ability (ability to think analytical-creative in science) and students’ creativity in chemistry material. Topic adopted is Buffer and the reason to choose buffer solution lesson is that this lesson has theory, calculation and practice. Hence, the cognitive, affective and psychometric aspects are able to be observed. The implementation of 7E Learning Cycle model is expected to influence students’ integrated skills and creativity.

The rest of this paper is organized as follow: Section 2 describes the material and proposed research method. Section 3 presented the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Material & Method
This section describes the material and proposed research method.

2.1 Data
Data collection technique is a strategy to obtain data. Data collection technique is conducted in the study:

- Documentation, is used to obtain data on students’ initial abilities. Initial ability is obtained from the value of daily tests of previous material.
- Observation, is useful in observing learning activities and students’ independence when learning.
- Questionnaire, is used to obtain data on learning activities and students’ independence.
- Test, is useful in measuring integrated skills (analytical thinking skills and science process skills).
The Post-test assessment criteria of integrated thinking skills is presented in Table 1:

**Table 1. Post-test assessment criteria of integrated thinking skills**

| No | Score range  | Category |
|----|--------------|----------|
| 1  | $X > 30.3$   | Very high|
| 2  | $23.1 < X \leq 30.3$ | High   |
| 3  | $15.9 < X \leq 23.1$ | Moderate |
| 4  | $8.7 < X \leq 15.9$ | Low    |
| 5  | $X \leq 8.7$  | Very low |

Data from students’ creativity meet the criteria in the following Table 2:

**Table 2. Assessment criteria of questionnaire for students’ learning creativity**

| No | Score range  | Category |
|----|--------------|----------|
| 1  | $X > 74.8$   | Very high|
| 2  | $61.6 < X \leq 74.8$ | High   |
| 3  | $48.4 < X \leq 61.6$ | Moderate |
| 4  | $35.2 < X \leq 48.8$ | Low    |
| 5  | $X \leq 35.2$  | Very low |

After categorizing the data, a prerequisite analysis test needs to be completed. Some prerequisites which must be fulfilled before testing hypothesis using MANOVA are that dependent variable is measured in interval data and ratio, independent variable consists of two or more categories, the observation is independent, the number of samples must be adequate, there is no univariate or multivariate outliers, there is multivariate normality, there is a linear relationship between each pair of dependent variables and each independent variable, it has covariant metric homogeneity and there is no multi-collinerity.

2.1.1 **Multivariate Normality**

Normality test is useful for knowing whether the data is normally distributed or not. The normality test used in the study was based on the ratio of the cost of an aerobic distance and the chi square value using SPSS software (Statistical Product and Service Solutions). Data can be said to be normally distributed if the significance is greater than 0.05 or p-value > 0.05 at a significance level of 5%.

2.1.2 **Homogeneity of Co-variance Metric**

A homogeneity test is useful for testing experimental class data and the control class has homogeneous variance or not. In multivariate analysis of variance (MANOVA) requires that the matrix variance of the dependent variable use the M-Box test. Data can be said to be homogeneous if the significance value > 0.05 or p-value > 0.05 at a significance level of 5%.

2.1.3 **Correlation Test**

Correlation test is useful for knowing the relationship between one variable and another. Correlation test in this study uses Pearson test with the help of SPSS software. The data has correlation if the significance value was less than 0.05 or $p < 0.05$ at a significance level of 5%. If the hypothesis prerequisite test is fulfilled, then MANOVA analysis is performed using SPSS to determine the
difference between the experimental group and the control group. Correlation data is significant if the significance value is less than 0.05 or \( p < 0.05 \) at significance level of 5%.

### 2.2 Method

This type of research is a quasi-experimental research because not all variables appear and experimental conditions can be regulated and tightly controlled [13]. The research design was Post-test-only control design with the research design is presented in Table 3.

#### Table 3. Research Design for Post-test-Only Control Design

| Group         | Experiment | Post-test |
|---------------|------------|-----------|
| Experimental class | \( X_1 \)   | \( O_1 O_2 \) |
| Control class  | \( X_2 \)   | \( O_1 O_2 \) |

Where:

- \( O_1 \) = integrated analytical process
- \( O_2 \) = final learning activity
- \( X_1 \) = the learning using 7E learning cycle model
- \( X_2 \) = the learning use expository learning

In this study using, a sample of 64 students consisting of two classes, the experimental class with 33 students and the control class with a total of 31 students taken from one school in Yogyakarta, Indonesia. The sample used is cluster random sampling technique. The experimental class was treated with the implementation of the 7E learning cycle learning model while for the control class using expository learning.

### 3. Results and Discussion

This section presents the result and discussion of this work.

#### 3.1. Result

#### 3.1.1. Descriptive Analysis

Descriptive analysis plays a role in describing the object under study through data obtained from research results. The data obtained from the research results include data on initial ability, Post-test data for analytical thinking skills and chemical science process skills, Post-test for creativity of learning. The results of descriptive analysis were interpreted into predetermined criteria. The assessment criteria used in the study are presented in Table 4 which is adopted from [14].

#### Table 4. Ideal Assessment Criteria

| No | Score Range                  | Category   |
|----|------------------------------|------------|
| 1  | \( X > M_i + 1.8 S_i \)     | Very high  |
| 2  | \( M_i + 0.6 S_i < X \leq M_i + 1.8 S_i \) | High       |
| 3  | \( M_i - 0.6 S_i < X \leq M_i + 0.6 S_i \) | Moderate   |
| 4  | \( M_i - 1.8 S_i < X \leq M_i - 0.6 S_i \) | Low        |
| 5  | \( X \leq M_i - 1.8 S_i \)  | Very low   |

Based on the evaluation criteria formula in Table 4, the criteria for evaluating the results of Post-test for integrated thinking skills are obtained in Table 5 below.
Table 5. Assessment Criteria of Post-test for Integrated Thinking Skills

| No  | Score Range         | Category   |
|-----|---------------------|------------|
| 1.  | X > 30.3            | Very high  |
| 2.  | 23.1 < X ≤ 30.3     | High       |
| 3.  | 15.9 < X ≤ 23.1     | Moderate   |
| 4.  | 8.7 < X ≤ 15.9      | Low        |
| 5.  | X ≤ 8.7             | Very low   |

The acquisition score is the number of scores successfully achieved by students based on the results of Post-test for analytical thinking skills and chemical science process skills. Maximum ideal score is the highest score that can be achieved by students in answering all questions correctly. Based on Tables 4 and 5, the percentage of each class, experimental class and control class was obtained. Data analysis above revealed that experimental class and control class were not much different in the percentage difference. The criteria for each class can be seen in Table 6.

Table 6. Assessment Criteria of Post-test for Integrated Thinking Skill (Experiment)

| No  | Number of students | Percentage |
|-----|--------------------|------------|
| 1.  | 6                  | 18.1%      |
| 2.  | 18                 | 54.5%      |
| 3.  | 8                  | 24.2%      |
| 4.  | 2                  | 6.06%      |
| 5.  |                    |            |

Based on Table 6, the percentage of each category showed that the largest category of other categories was the highest category with a percentage of 54.5% who are 18 participants from a total of 33 students in experimental class and no students included “Very low” category. The results from control class were categorized in Table 7 below.

Table 7. Assessment Criteria of Post-test for Integrated Thinking Skills (Control)

| No  | Number of students | Percentage | Category   |
|-----|--------------------|------------|------------|
| 1.  | 5                  | 16.1%      | Very high  |
| 2.  | 17                 | 54.8%      | High       |
| 3.  | 1                  | 25.8%      | Moderate   |
| 4.  | 1                  | 3.22%      | Low        |
| 5.  | 1                  | 3.22%      | Very low   |

Based on Table 7, the percentage of each category showed that the largest category was in "High" category with a percentage of 54.8% of 17 students from a total of 33 students in the control class. Each statement has a maximum score of 4 and a minimum score of 1, so that based on Table 4, the criteria for evaluating the final learning creativity of the students was presented in Table 8.

Table 8. Assessment Criteria of Questionnaire for Students’ Learning Creativity

| No  | Score Range | Category |
|-----|-------------|----------|

| 5 |
Table 8 revealed that both experimental class and control class were in “Moderate” category as their highest category. There was only one student who chose “High” in each class.

3.1.2. Multivariate Normality
Data were normally distributed if the significance is greater than 0.05 or p-value > 0.05 at a significance level of 5%. The experimental class and control class data were normally distributed because of its greater significance than 0.05.

3.1.3. Homogeneity of Co-variance Metric
Similar to multivariate normality, data for homogeneity of co-variance matrix will be homogeneous if the significance value is greater than 0.05 or p-value > 0.05 at a significance level of 5%. Data from experimental class and control class were homogeneous because the significance was greater than 0.05.

3.1.4. Correlation Test
Data are correlated if the significance value was greater than 0.05 or p < 0.05 at a significance level of 5%. At this stage, there was a correlation between the integrated skills with students’ creativity in learning in the experimental class, however control class did not show the same result. The following data are MANOVA analysis using SPSS to find out the influence of 7E learning cycle model on integrated skills and students’ creativity in learning for both classes. The obtained data demonstrated that there was an influence of 7E learning cycle model on integrated abilities, and students’ creativity in learning for both classes.

3.2. Discussion
The data collected in this assessment is the integrated ability and students’ creativity. Buffer solution test consisting of 5 essay questions followed by a questionnaire of students’ creativity in the teaching and learning process takes place and is carried out in each class. Analysis of the effect on integrated ability and creativity of students is done using MANOVA. The results obtained from MANOVA techniques showed that there is an influence of learning cycle model on both variables, namely the integrated ability and students’ creativity. Before that, the obtained data were tested by prerequisite test such as normality test in order to know whether the data is normal. Normality test was performed on the obtained data before treatment or after treatment. The normality test in this study was conducted on post-test data for integrated skills and students’ creativity. The experimental class used 7E learning cycle model and control class used expository learning.

The results obtained from MANOVA techniques showed that there is an influence of learning cycle model on both variables, namely the integrated ability and students’ creativity. Before that, the obtained data were tested by prerequisite test such as normality test in order to know whether the data is normal. Normality test was performed on the obtained data before treatment or after treatment. The normality test in this study was conducted on post-test data for integrated skills and students’ creativity. The experimental class used 7E learning cycle model and control class used expository learning.

The normality test used in the study was based on the ratio of the cost of an aerobics distance and the chi square value using SPSS software (Statistical Product and Service Solutions) which showed that the data from the experimental class and control class were normally distributed. After that, homogeneous test and correlation test on both variables were performed. Homogeneous test and correlation test showed that the data was homogeneous and there was correlation in both variables. The results of this study particularly the influence of integrated 7E learning cycle models to analytical thinking, integrated science process skills and students’ creativity is still rare. However, one of the studies from [15] revealed that students who learn using 7E learning cycle model showed that they had
analytical thinking and their achievement in science and attitudes towards chemistry learning was higher than those of learners who learn with KWL learning and conventional approaches. This study showed that there was an influence of 7E learning cycle model to critical thinking along with creativity [16] in which show there was an increase in mastering critical thinking skills and creativity taught 7E learning cycle model and guided inquiry. The results of the research from [17] also showed that there was an influence of 7E learning cycle model to integrated science and critical thinking skills. The stages of 7E learning cycle model according to [12]) are explained as follows:

- **Elicit**, in this phase the teacher tries to find out where the students' knowledge on material that will be learned by giving questions that stimulate students' initial knowledge,
- **Engage**, this phase is used to focus on students’ attention, as well as to arouse students’ interest and motivation towards the material to be studied by telling stories, conducting demonstrations, and watching pictures or videos,
- **Explore**, in this phase the teacher provides opportunities for students to observe, record data, isolate variables, make graphs, analyze results, develop hypotheses, and organize their findings,
- **Explain**, in this phase students conclude the findings and present the results from explore phase, while the teacher introduces students to some new scientific vocabularies and provides feedback on conclusions that have been raised by students,
- **Elaborate**, in this phase students are given the opportunity to apply their knowledge to new situations. It can be in the form of further questions or quantitative questions related to the subject matter,
- **Evaluate**, this phase is used to assess students’ level of understanding after learning that has been done using formal and informal assessment,
- **Extend**, in this phase, the teacher guides students to implement their knowledge gained in the new context and can be done by connecting the material that has been learned to the next material.

Implementation of 7E learning cycle model helps the teacher find out the students’ integrated skills and 7E learning cycle model also helps students more use their creativity to solve problems in the stages of the learning process.

4. Conclusion
The 7E learning cycle model helps students shape their analytical skill and science process, so their creativity will develop. It means that there is an influence of 7E learning cycle model to students’ analytical thinking skill and creativity based on the result of analysis using MANOVA. 7E learning cycle model is also a model that makes students find out and solve a problem in narration. That also makes students think analytically to solve the problem, and science process in learning lead students think creatively to solve the problem. Besides, the weakness when implementing 7E learning cycle model is time allocation in that this model is complex, thus the time allocation in the school is limited. In implementing 7E learning cycling model, the researcher is able to know the relationship between analytical thinking skill and science process skill and students’ learning class in which those are the goals of 2013 curriculum (K13) in Indonesia. Therefore, researchers who want to study about this research are expected to continue the researcher in greater number or to add variable which still be studied.

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