Implementation of the STEM Model (Science, Technology, Engineering and Mathematics) with Blue Flower (Clitoria Ternatea) to Improve the Creative Thinking Skill of High School Students

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Keywords: STEM Model, Blue Flowers (Clitoria Ternatea), Benzena.

Abstract: The purpose of this study was to assess learning STEM model with blue flowers (Clitoria Ternatea) to improve understanding of concepts and conceptual thinking skills of high school students on the Acid based Concept. This research is quasi-experimental, with a total of 30 study subjects MIA1 class XI students and as many as 26 students at SMAN 2 MIA2 class city of Ternate in North Maluku province. The instrument used was a test concept mastery acid base with critical thinking skills (conceptual thinking), observation sheets and questionnaires were used to determine the responses of teachers and students. The STEM model in the chemistry learning have three level: product, process and promotion with proses Science Skill. Improved learning outcomes on the concept of acid base are the highest in the experimental class to label the concept the average of N-Gain 85.60, while the lowest on the label concepts Physical and chemical properties of acid base at 66.00. In the control class improved learning outcomes were highest on the label concept Acid base Theory has N-Gain at 30.81 while the lowest on the label concept Acid base titration usefulness in daily life N-Gain at 64.10. The teacher and students in general to chemistry learning with STEM Model based on blue flowers media are very positive.

1 INTRODUCTION

Chemistry grow and develop based on the experiments it can be concluded that the chemical is an experimental science. Learning chemistry requires laboratory activities are supported by appropriate design of the learning model strongly supports the development of these processes in higher cognitive areas, such as preparing hypotheses, predict, and concludes.

Chemistry learning objectives is to assist students in developing competencies cognitive, psychomotor and affective that includes finding the data, collecting and processing data and using logic to a conclusion and decision making. Students need to know the causes of natural phenomena and to develop strategies for solving problems.

Learning chemistry is an integral part of learning science by most students is still considered a hard lesson. This is because the nature of the chemistry concepts that have a high abstractness and complexity. Russell et al. (1997) and Bowen (1998) stated that in order to understand the chemistry conceptually, requires the ability to represent and interpret problems and chemical phenomena into a representation in the form of macroscopic, microscopic, and symbolic simultaneously. In the process of learning expected of teachers need to emphasize the transition between the world of the symbolic, macroscopic and microscopic so that students can develop their own mental models to three levels; especially the microscopic level is known to increase students' conceptual understanding (Kam-wah and Lee in Wahyuni, 2007).

One of the capabilities that are expected to be held by the students after learning chemistry is a problem solving ability. Kilpatrick et al (2001) stated that the ability to formulate, present, and complete problem solving referred to as a strategic competency. With adequate strategic competencies expected of students able to solve the problems faced by both the subject matter and the chemistry of everyday life (literate students to science).

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To achieve this capability requires a model of learning chemistry more effective and emphasis on students' thinking skills. One study design used here is the type of techniques Hands-on Explorer Challenge Activity. Problems in learning a learning stimulus (Barrows, 1996).

This problem is bridging the relationship between the content learned in the context of (real-world situations). The students face a situation problem solving in small groups led by tutors. Tutors assist students in identifying the knowledge required to solve the problem by asking questions and monitoring the problem-solving process.

Chemistry material selected in this study, namely benzene and its derivatives have the kind of concepts that are abstract concrete. Besides the problem of benzene is very close to daily life. Issues of Benzene and its use is very close to their lives. So students need to be introduced on a contextual phenomenon.

One of the issues about the topic Benzene students are introduced about synthetic pesticide compounds as well as cases that arise in the community, has appeared many complaints related to the high content of toxic chemicals in food ingredients that cause various diseases, such as stroke, blood vessel constriction , and poisoning the body. The farmers and people still have a strong desire to use pesticides because of the results obtained more quickly seen and felt immediately. Although it must be admitted that the use of synthetic chemicals is able to increase production, but did not realize that the accumulation of the use of synthetic chemicals can cause problems such as a high content of residues in products, lead to resistance, resurgence, and the explosion of pests and diseases will even happen disturbance environment life.

In this study, researchers will be introduced by the media about the learning that will be used in the learning Benzene Blue Flower (Clictoria ternatea). These flowers grow in areas Kalumata, Teak and Gambesi in Ternate. People usually use it as a traditional treatment for the disease asthma / shortness of breath. This interest has not been cultivated by the people that still grows wild. Blue flowers used as a medium of learning because this compound contains phenolic compounds namely Benzene derivatives. In the research project is designed in the form of worksheets students are required utilizing as biopesticides or blue flowers as natural indicators.

Based on the background of the problem, the characteristics of the concept of benzene and its derivatives, as well as the application of concepts in learning the researchers tried to design a study entitled, "Learning the techniques of chemical types Challenge Hands-on Activity Explore the Blue Flower (Clictoria Ternatea) on the topic of benzene and its derivatives to improve skills Conceptual thinking high school students."

1.1 Problem Formulation

Based on the background research that has been stated previously, the research problems can be formulated as follows:

1. How do the characteristics of the STEM media model with blue flowers in chemistry learning improve students' creative thinking skills?
2. How to increase understanding of concepts and students' creative thinking skills through the media of Blue Flowers on the concept of Benzene with implementation STEM model?
3. How do the teacher and students respond with chemistry learning STEM model with Blue Flower (Clictoria ternatea)

1.2 Research Objectives

Based on the formulation of the problem, the objectives of the study are to:

1. Identify the characteristics of the type of STEM model with Blue Flower (*Clictoria Ternatea*) on the topic of Acid base can enhance high school students' conceptual thinking skills.
2. Find ways of making learning media of blue flowers (Clictoria ternatea) on the topic of Acid and base can enhance creative thinking skills for student SMAN 2 Kota Ternate Class XI.
3. Identify increasing student mastery of concepts in the concept of benzene and its derivatives through learning techniques Hands-on types Challenge Explore Activity with Blue Flower (Clictoria Ternatea)

1.3 Benefits of Research

The findings in this study are useful for:

a) High School Chemistry Teacher, the findings could be used as an addition to insight, knowledge and skills in designing, using and developing an innovative learning chemistry, as an operational guideline in applying learning techniques oriented Hands-on especially on the concept of Acid and base in learning chemistry; For chemistry learning student learn about Acid based and implementation topics i their life.

b) For fellow researcher and observer of Education, the findings could be used as a source of information for the development of chemistry teaching models, as input to the school to solve the problem of quality of learning and teaching as a reference on innovation.

2 RESEARCH METHODOLOGY

2.1 Methods and Research Design

The research method used in this study is an experimental method. This study focused on the development of chemistry teaching model that can improve conceptual thinking skills and science literacy and utilize media blue flowers (Clitoria Ternatea) in learning Acid and Base Compounds.

The research was conducted using Pre-test – post-test control group design. In the research design, there are the steps that show a sequence of research activities, the stages in the experimental class, namely: (1) initial observation phase (O), (2) stage treatment model (X1), (3) the final Observation (O), while stages of the control class, namely: (1) initial observation phase (O), (2) conventional learning phase (X2), (3) the end of the observation phase (O).

2.2 Subjects of Research

This research was conducted in the city of Ternate SMAN 2 semester academic year 2017/2018. The subjects in this study were: class XI students MIA1 and MIA 2 that were 30 people in the experimental class and 26 in the control class. The reason for the selection of study subjects was based on the consideration that all students who are in science classes were grouped by ability in the class of homogeneous existing (five classes).

2.3 Research Procedures

Stages of the procedure adopted in this research include:

2.3.1 Preparation Phase

At this stage the two activities, namely the preparation of the learning and development of research instruments. The first step begins with: a) Study of the literature of the Chemistry , Subject Syllabus and books chemistry to analyze the key concepts in the learning process needs to be trained with the skills to think conceptually, b) make the analysis of the concept to determine the label concepts, definitions of concepts, types concepts, attributes of concepts, concept hierarchy, c) create concept maps covering the relevant concepts by using conjunctions, d) conceptual skills study to determine the indicators that will be developed in , e) Learning blue flowers and prepare media and create learning scenarios in which damage that there is a definition of the concept, specific learning objectives with the worksheet, the model STEM for chemistry learning implementation.

2.3.2 Implementation Phase

At the beginning of the meeting students were given pre-test; further divided into groups of students practice working with worksheets prepared by the researcher.Student can explain what is they see and remember about acid and base compounds, Indicator acid base and pH Acid base. Later stages of the application of learning by STEM model so student learn in level interactive demonstration student can demonstration and talk with another in class. Teacher prepare their module, LKS or examination on virtual class and virtual laboratory. Student learn by Flipped classroom in experiment class. On the class control student learn by inquiry laboratory without virtual class. Both of class make some project acid base.

All the student to study learn about Worksheet with the blue flowers (Clitoria Ternatea). They learn about the media characteristics of blue Flower and then they make some extracts of blue Flower for some products of chemistry in life. After that they make promotion their product to their colleagues or family. Then the implementation of learning is observed by peers as an observer by teacher and parents. In this study, sampling data through observation sheet involving two observers (peers) are performed on the control class or classes of data observations collected from the experiment. The next step is performed percentage of each observation point.

3 RESULTS AND DISCUSSION

3.1 Mastery of Concepts

To determine the increase of students' mastery of concepts and data captured by sub-concepts achievement posttest scores of each item to the class about the control and experimental classes. The number of concepts students are learning as much as 5 sub concepts spread into 20 question multiple choice test. These concepts are (1) Acid base theory, (2) acid base indicator, (3) determine strong acidic base compounds and weak base through calculation of acidic strength, (4) Determine weak acidic and strong base compounds , (5) Purpose and Useful Acid and base of in daily life. Distribution for each concept and picture for each individual concept can be seen in Figure 1, Table 1 and, Table 2.

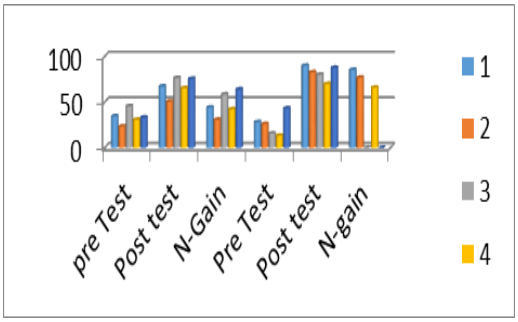

Figure 1: Pre-test, Post-test and N-Gain Results.

Table 1: Distribution of Sub-Class Concept in Control and Experimental Classes.

No.	Mastery of Concept	Question Number	Average Control Class			Average Experimental Class		
			Pre-test	Post-test	<g> (%)	Pre-test	Post-test	<g> (%)
1.	Acid Base Theory	1, 2,4,13,20	34.62	67.31	44.23	28.33	90.00	85.60
2.	Acid Base Indicator	3, 16,15,11	23.40	50.64	30.81	26.11	82.78	77.00
3.	Determine strong acidic base compounds and weak base through calculation of acidic strength	5,6,12, 19	45.51	76.60	58.61	15.83	80.28	76.00
4.	Determine weak acidic compounds and strong acids	7,8, 9 10,18	30.77	65.38	42.31	13.33	70.00	66.00
5.	Usefull Acid and base in daily life	14,15,16,17	33.33	75.64	64.10	43.33	87.78	78.00

Based on table 1 that student learning outcomes are integrated into the conceptual thinking skills and science literacy skills of students with STEM (Science, Technology, Engineering and Mathematics) model in learning chemistry. Worksheet addressed that there is a significant result with class control and experimental classes. The difference in the second-class treatment in this study lies in the provision of different worksheets and learning techniques are different between the two classes.

STEM model in the experimental class on the label concepts Acid and base theory and indicator acid base have a value of N-Gain 66.00 which most students think that the concept is difficult to

understand and a lot of memorizing concepts. Lack of understanding of the concept as traced through interviews and questionnaires it was found out the fact that students are still confused with the label concepts as to count pH strong acid and base. It is still difficult for the students to distinguish strong acidic compounds and weak acids through the calculation of acidic strength. So label the concept the acid base theory and indicator acid base had a concept that can enhance the understanding of science concepts and literacy achievement of students with the highest value of N-Gain which is equal to 85.60.

Table 2. Distribution Sub-Class Concept at Grade Control and Experiment.

No.	Mastery of Concept	Question Number	Average Control Class			Average Experimental Class		
			Pre-test	Post-test	<g> (%)	Pre-test	Post-test	<g> (%)
1.	Acid Base Theory	1, 2,4,13,20	34.62	67.31	44.23	28.33	90.00	85.60
2.	Acid Base Indicator	3, 16,15,11	23.40	50.64	30.81	26.11	82.78	77.00
3.	Determining strong acidic base compounds and weak base through calculation of acidic strength	5,6,12, 19	45.51	76.60	58.61	15.83	80.28	76.00
4.	Determining weak acidic compounds and strong acids	7,8, 9 10,18	30.77	65.38	42.31	13.33	70.00	66.00
5.	Useful Acid and base in daily life	14,15,16,17	33.33	75.64	64.10	43.33	87.78	78.00

It can be seen from the results of table 2, which shows that concept of interest to students the concept label uses and hazards of acid base in daily life, can improve conceptual skills N-Gain of 78. Students are very interested in this concept because a group of students the opportunity to develop and create a chemistry project on Acid base applications in daily life. Refers to the types of concepts that are presented by Herron (1997) Benzene in learning chemistry concepts, there are three types of concepts such as: the concept based on the nature, the concept which states the principles and concepts expressed. Lack of understanding of the concept of physical and chemical properties of benzene and its derivatives is a kind of concept based on the principle in which weeks to understand the types of concepts necessary knowledge of the principles previously been known or studied by students.

3.2 Discussion

3.2.1 Learning by STEM model

Based on the data in Table 4.4 application of learning techniques Hands-on Explorer Challenge Activity Types with blue flowers is a technique that requires students to think, to improve the skills of thinking conceptually. Characteristics of STEM

models are Product Promotion and Process. STEM model can improve the ability to ask questions of the object or phenomenon that confronted students. The ability to ask who directed this research is the ability to ask that is directed at the concept of the use of tools.

3.2.2 Student Responses on Learning

In general, student responses on learning chemistry Acid Base concept by instructional media of blue flowers (Clitoria Ternatea) is very positive. Based on the questionnaire that were distributed to the students turned out by blue flowers media in chemistry learning improve students' understanding of the concept of high and especially on a concept by implementing the principles. One of the skills that students should have when the investigation is asked so that they can get the data and process it logically (in Suchman, 2004:86). Suchman explains that the ability to ask questions is a skill that students can learn about how to (1) ask the question unfocused and blurry, (2) analyze a situation to resolve relationships among variables.

3.2.3 Conceptual Skills of Students' Mastery in learning through STEM (Science Technology, Engineering and Mathematics) with blue flowers (Clitoria Ternatea) media.

The results of data analysis for students Critical Thinking Skills, developed through learning benzene and its derivatives through STEM model as a whole that have increased in the experimental class were quite high, with an average N-Gain ranging from 55.56 to 73 , 67. Improvements in Critical Thinking Skills can be caused by students acquire factual knowledge directly observed from lab-based project that is packed with the questions in the worksheets that direct students to relate the facts obtained in the form contributed to theory in improving students' Creative Thinking Skills. The students' Creative Thinking Skills increase on aspects of tables and graphs generalize (73.67), suggesting that this explanation is supported by the theory of learning techniques and media used; then directed students to be able to represent the tables and graphs are created each presents a project report. In LKS design students were asked to present the work of the group and subsequently addressed by other groups. Students also find themselves patterns and regularities, and tables and charts, as well as trained to analyze tables and graphs. Judging from the test questions are not about the difficult category, including the category of test and easy, it can be one cause of high Creative Thinking Skills on generalized tables and graphs.

For aspects of Creative Thinking Skills on answering the question "what is ...?" an increase of 63.89. This could be due to the students easily understand the meaning of the concepts learned there as to Acid base theory, Acid base indicator, the pH of strong acid and strong base , the pH of strong acid and weak base , and the pH of weak acid and weak base . For Creative Thinking Skills in identifying aspects or formulate criteria for determining a possible answer increased by 59.17.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Characteristics of learning chemistry with STEM model are with blue flowers (Clitoria ternatea) are: to facilitate students in foster creative attitude, work in groups, ability to hypothesize, problem-solving skills, motivation to learn and be able to increase the ability to ask the object or phenomena.

1. Improved learning outcomes on the concept of benzene and its derivatives are the highest in the experimental class to label the concept The structure and name compounds and benzene derivatives average of N-Gain 85.60, while the lowest on the label concepts Physical and chemical properties of benzene at 66.00. In the control class improved learning outcomes were highest on the label concept substitution reaction of H atoms in benzene have N-Gain at 30.81 while the lowest on the label concept Benzene usefulness in daily life N-Gain of 64.10.
2. Improved conceptual thinking skills in classroom experiments the highest occurred in Critical Thinking Skills ability to justify the N-gain of 76.89 and the lowest at the Critical Thinking Skills look for similarities and differences of 57.56. Then the control class saw the largest increase in the Critical Thinking Skills analyzed the table and graph at 48.74 while the lowest in the ability of the Critical Thinking Skills to justify N-gain of 35.63.
3. The teacher and students in general to learning Acid Base Concept with media blue flowers are very positive

4.2 Suggestion

The science teachers can make learning particularly chemical STEM model the various types that are tailored to the characteristics of the material and the level of difficulty of the teaching materials that can be delivered to students.

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