

## **OCCIE Learning Model to Improve Science Process Skills and Responsibility of Senior High School Students**

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**Abstract:** Learning models that can improve science process skills and student responsibilities include the Problem Based Learning (PBL) model and the Inquiry model. But the results of the study show that the PBL model and Inquiry still need to be improved to improve science process skills and student responsibility, especially in chemistry learning. Learning models that are designed based on theoretical studies and empirical studies form the syntax of OCCIE learning models with phases, namely 1) Orientation, 2) Construct, 3) Communicate, 4) Improve, 5) Evaluate. The purpose of this model is to improve science process skills and the responsibility of high school students.

**Keywords:** OCCIE Learning Model, Science Process Skills, Responsibility.

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### **I. Introduction**

Science process skills and responsibilities are a unit that cannot be separated. Chemistry learning in high school must pay attention and emphasize the learning of chemistry that can improve science process skills and responsibility in solving problems they face. Science process skills are systematic, experimental, and systematic scientific inquiry abilities as the basis of scientific science literacy<sup>[1-2]</sup>. Science process skills can be classified into basic skills and integrated process skills<sup>[3-5]</sup>.

Science process skills, both basic science process skills and integrated science process skills must be trained to students so that students not only become recipients of information, but also can search information related to things learned. The results of the study show that when early science process skills are low<sup>[1,6]</sup>, it will inhibit the chemistry learning process in the classroom. This shows the importance of science process skills to be possessed by students and used in chemical learning.

The results of the preliminary study on class XI students at SMAN 18 Surabaya who took chemistry lessons in the material for material equilibrium study found that chemical science process skills were still low. Indicators of science process skills consist of formulating problems, making hypotheses, identifying experimental variables, defining operationalization of experimental variables, designing and carrying out experiments, analyzing data, and concluding that 78 students score below 50 out of 96 students of class XI or 81% in the low category. This shows the science process skills of high school students in chemistry learning are still low.

Learning models that can improve students' science process skills include the Problem Based Learning (PBL) model and the Inquiry model. This is explained by several experts<sup>[6-15]</sup> which states that the PBL model has a general goal to improve inquiry skills and problem solving skills, behavior and social skills according to the role of adults, the skills for independent learning. The PBL model still has several obstacles that must be overcome if it wants to use it more broadly. The barriers to the PBL model are less suitable for large information coverage or basic knowledge and some teachers do not encourage their use<sup>[15]</sup> The results of the meta-analysis by<sup>[16]</sup> on the results of the 2006 to 2013 studies indicate that PBL learning is effective in learning to train students' attitudes. Another finding is that the learning environment needs further attention, so students need to understand the PBL model and master the concept first.

<sup>[17]</sup> Conducted a study with 34 samples using the PBL model, the results obtained showed PBL weaknesses one of which was PBL effective when students had mastered the basic concepts to solve problems. When students do not have and do not understand the basic concepts, students have difficulty in solving problems. The results of research by<sup>[18]</sup> found that in a sample of 24 prospective teacher students using PBL can improve student physics teacher learning outcomes, but the ability to investigate (science process skills) to solve problems is still low. Some limitations of PBL are broader in scope by increasing attention to the nature of contemporary science and its applications<sup>[19]</sup> and PBL will be more successful if students are responsible for their own teaching and learning process<sup>[20]</sup>. The results of the study on the PBL model above indicate the

importance of innovation in the PBL model to improve science process skills and responsibility for chemistry learning.

One learning model designed to meet the needs and challenges faced by 21st century students is inquiry <sup>[21]</sup>. Inquiry learning can develop students' ability to formulate explanations based on data / evidence, evaluate scientific explanations <sup>[22]</sup>. Through the process of investigation and discovery students create new, creative and independent knowledge, and analyze opinions <sup>[21]</sup>. Based on some of the results of the above research, inquiry is a superior model for learning at school. Further research, the Process-Oriented-Guided-Inquiry-Learning (POGIL) model is widely used to improve problem solving skills <sup>[23,24]</sup>, confidence, and academic value students <sup>[25]</sup>. However, it takes a lot of time to observe, draw and write activities <sup>[26,27]</sup> <sup>[28]</sup> applies POGIL-based learning in laboratory activities. The results showed that the highest academic value was dominated by students who were actively involved in investigative activities, and vice versa for students who were not actively involved in investigating activities would have less satisfactory academic value. More studies are needed to condition that active students in inquiry activities use science process skills when resolving the problems they face responsibly. The results of the literature review above indicate the need for innovative models based on weaknesses in inquiry models that are used specifically by design to improve science process skills and the responsibilities of high school students especially on chemistry subjects.

The attitude of responsibility is the ability to work with the interests of the wider community, inspire others by example, and utilize the strengths of others to achieve common goals. Responsibility is the behavior to do the best during the learning process which includes participating, respecting others, cooperating, leading, and expressing opinions [29]. Students are said to be responsible if they can utilize knowledge to solve problems in real life situations, understand the meaning of learning, adopt their own attitudes and points of view, and strengthen the responsibility for self-learning [30].

Problems arising from the results of previous studies and literature review of the Problem Based Learning (PBL) model and Inquiry model, the results of preliminary studies at SMAN 18 Surabaya above show that in general science process skills and the responsibilities of high school students in chemistry learning are still low. The researcher proposes the development of a chemical learning model that integrates science process skills and responsibilities. This innovation is expected to be an alternative solution to problems related to 21st century skills, implementation of the 2013 curriculum, and to improve science process skills and responsibilities of high school students in chemistry learning. Therefore in this study a learning model will be developed Orientation, Construct, Communicate, Improve, Evaluate (OCCIE) to improve the science process skills and responsibilities of high school students in chemistry learning.

## **II. Discussion**

### **1. Developed OCCIE Learning Model**

<sup>[31]</sup> Suggested that the learning model must have five characteristics of the model, namely syntax, social system, reaction principle, support system, and instructional and accompaniment impacts. The model developed refers to the problem solving process and overcomes weaknesses in the PBL model and inquiry. The rationality of the sequence of each phase in the learning model that will be developed is reviewed based on researchers' arguments, theoretical studies, and empirical studies

Researchers designed a picture of a learning model that was designed based on theoretical studies and empirical studies to form the syntax of learning models with phases, namely 1) Orientation, 2) Construct, 3) Communicate, 4) Improve, 5) Evaluate. The purpose of this model is to improve science process skills and the responsibilities of high school students. In this model students are required to be active in routine and non-routine problem solving activities to improve science process skills and student responsibility is reflected in each phase of the OCCIE model. The chemistry learning model developed was named the learning model Orientation, Construct, Communicate, Improve, Evaluate (OCCIE). The OCCIE model was developed as an alternative solution to overcome the weaknesses of the PBL model and inquiry model.

### **2. Objectives of the Development of the OCCIE Learning Model**

The learning model Orientation, Construct, Communicate, Improve, and Evaluate (OCCIE) developed has the purpose of teaching students about mastery of competencies including: a. improving science process skills and b. increasing the responsibility of high school students in chemistry learning.

### **3. OCCIE Learning Model Components**

#### **a. Syntax**

The OCCIE learning model developed consists of five phases, namely 1) Orientation, 2) Construct, 3) Communicate, 4) Improve, and 5) Evaluate.

### **b. Social System**

The OCCIE social system model refers to Dewey's problem solving process and Vygotsky's social constructivist theory which emphasizes knowledge construction through sharing between students.

- 1) Pro-active students in inquiry-based learning activities and solving routine and non-routine chemical problems by contributing to the process of science process skills and responsibility.
- 2) The teacher acts as a guide, moderator, facilitator, consultant and mediator in the learning process to improve science process skills and the responsibilities of high school students in chemistry learning.

### **c. Principle of Reaction**

The principle of reaction relates to how the teacher values and responds, including how the teacher asks questions, answers, and responds to what the student is doing. In the OCCIE model, the teacher acts as a facilitator and moderator. As a facilitator, the teacher provides learning resources, encourages students to learn science process skills and responsibilities, provides assistance for students to learn and build their knowledge optimally. As a moderator, the teacher leads the class discussion, arranges the course of the discussion, and directs the discussion so that the expected results can be achieved. The expected reaction principle is as follows:

- 1) The teacher acts as a moderator when students communicate the results of science process skills.
- 2) Providing and managing realistic and relevant learning resources that support students in carrying out science process skills activities and responsibilities.
- 3) Give attention to creating a conducive and dynamic atmosphere of scientific activities.
- 4) Directing students so that they can construct shared knowledge through group activities and class discussions.
- 5) Provide guidance to students in the form of adequate explanations if students experience difficulties.
- 6) Provide an opportunity for students to ask if there are those who do not understand about the activity of obtaining data or instructions in the student activity sheet or for other students to respond to it.

### **d. Supporting System**

The support system for a learning model is all the means, materials, and tools for implementing the OCCIE model. The OCCIE model support system, namely:

- 1) Learning devices refer to the OCCIE model, namely: Syllabus, RPP, LKS, Student Teaching Materials (BAS), instruments for assessing science process skills and instruments for evaluating student responsibility.
- 2) Chemical experiment tools and materials in the laboratory.
- 3) Learning media in the form of simulation labs and videos on a computer.

### **e. Instructional and Companion Impacts**

The instructional impact of the OCCIE model, namely:

- 1) Improve science process skills,
- 2) Increase responsibility.

Companion impacts are learning outcomes that are created from the learning process experienced by students with the direction of the teacher. The accompanying impact of the OCCIE model, namely:

- 1) Increase student activity in chemical learning,
- 2) Increase students' positive responses to chemistry.

## **4. Learning Environment**

Learning environment that can be formed through the implementation of the OCCIE learning model as follows. The learning environment in phase I: Orientation includes: 1) The teacher must be able to orient and motivate by explaining the importance of science process skills and responsibilities. 2) The teacher must be able to divide students into heterogeneous groups. 3) Students must pay attention to the orientation given by the teacher. The learning environment in phase II: Construct, includes: 1) Students must be able to implement science process skills in solving routine chemical problems in LKS I: Performance of Science Process Skills. 2) Teachers must be able to guide students in carrying out scientific activities responsibly. 3) Students in groups must construct science process skills with full responsibility through experimental activities.

The learning environment in phase III: Communicate includes: 1) Students communicate the results of chemical problem solving activities based on science process skills with full responsibility. 2) The teacher must be able to guide students to explore the results of the activities of science process skills, problem solving skills responsibly. Learning environment in phase IV: Improve, includes: 1) Teachers must guide in the implementation of self-regulated learning and metacognition in the process of training science process skills and student self-responsibility. 2) Teachers must be able to provide a comfortable atmosphere so that students are

able to improve their science process skills and self-responsibility. The learning environment in phase V: Evaluate, includes: 2) Evaluations carried out by the teacher in the learning process will improve the science process skills and responsibilities possessed by students. 2) Teachers must be able to create a comfortable and conducive environment so that students are able to optimize the evaluation process they do.

### III. Conclusion

Learning models that are designed based on theoretical studies and empirical studies form the syntax of learning models with phases, namely 1) Orientation, 2) Construct, 3) Communicate, 4) Improve, 5) Evaluate. The purpose of this model is to improve science process skills and the responsibilities of high school students. In this model students are required to be active in routine and non-routine problem solving activities to improve science process skills and student responsibility is reflected in each phase of the OCCIE model. The chemistry learning model developed was named the learning model Orientation, Construct, Communicate, Improve, Evaluate (OCCIE). Further research needs to be carried out to test the validity, practicality, and effectiveness of the OCCIE learning model.

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