Developing Chemistry Teacher's Ability to Design Inquiry-based Lab through Scaffolding type of Teacher Training Program

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Abstract. This study aims to develop chemistry teacher's ability in designing inquiry-based lab. Preliminary study showed that the chemistry teacher ability to design inquiry-based lab need to be developed. Teacher's training program with scaffolding strategy was selected to improve that ability. Twenty four chemistry teachers, who were involved in the Chemistry Teacher Council (CTC, also called MGMP Kimia) in Sumedang, and 60 students of class XI from two different schools were participated in this study. The instruments used were the test of designing inquiry-based lab, rubric to evaluate student worksheet (LKS) and rating scale questionnaire. The results showed that the ability to design inquiry-based lab increased with N-gain average was 0.8 or at the high category. The ability to assess the phenomenon of contextual and making steering questions had a highest mean N-gain is 0.9 at high category. Teachers gave positive responses about the training program generally, indicated by percentage of teacher’s response in strong and very strong criteria. Although teacher training with scaffolding strategy was newly applied in CTC, it helped developing teacher’s ability in designing inquiry-based lab and gave confidence to teachers to implement in their classroom.

1. Introduction

One of learning models that is recommended in the National Curriculum of 2013 is inquiry. Inquiry defined as multidirectional activities where the students make observations, ask questions, gather information from a variety of sources, planning and carrying out the investigation, using evidence to explain the question, use the tool to search, collect and interpret data; propose answers, questions, and predictions; and communicate the findings [1].

In lab-based inquiry learning, students are encouraged to use more high-level thinking skills, including the ability to think creatively [2]. Despite using more time than conventional lab, lab-based inquiry could encourage students to design their own steps of investigation based on the problems that arise after their observations of the phenomenon.

Teachers should be able to design appropriate learning model according to the times [3]. Therefore as one of the students determining factors in achieving certain competence, teacher needs to be improved to mention his ability on a regular basis.

The results of interviews with some of chemistry teachers in Sumedang, it was revealed that laboratory work in chemistry learning is usually done with another approach. Chemistry lab is often limited to verifying a concept that has been taught previously. The results from interview, indicating
that teachers are still experiencing difficulties in designing inquiry-based lab, and requires the existence of activities that can improve their competence.

This is shown in research that is often difficult to equip teachers and train inquiry to students because of the low ability of the teacher's inquiry [4]. The ability of teachers in packaging materials and develop LKS inquiry is still low and needs to be improved through various means [5]. Weak ability of teachers in designing the lab as one of the causes of the scarcity of teachers doing practical work in chemistry learning [6].

One of the alleged effective training model in developing the pedagogical competence of teachers is the Scaffolding type teacher training [7]. This type of training consists of four steps, namely the teacher does it, the class does it, the group does it, and the individual does it. The aims of this paper is to define development of chemistry teacher’s ability to design inquiry-based lab using scaffolding type of teacher training.

1.1. Teacher Ability to Design Inquiry-based Lab

There are seven aspects that could be expected to support the development capabilities of designing lab [8]: (1) determine the purpose of laboratory activities, (2) determine the type of trial, (3) determine the tools and laboratory materials, (4) determine the test series and describes the diagram, (5) to plan their own experimental procedures, (6) develop inquiry-based worksheets, and (7) designing evaluation laboratory activities.

1.2. Scaffolding Strategy

Scaffolding is a phrase that is used as a framework to illustrate how teachers can guide students through a learning task [9]. Scaffolding as a teaching strategy derived from Vygotsky’s sociocultural theory and the concept of the zone of proximal development (ZPD). People who are more expert or more knowledgeable other (MKO) will set up a scaffold or guidance to facilitate the development of students, so that students’ ability awakened by students' prior knowledge and ability to internalize new information. Activities are prepared only located above the stage to do the students themselves. MKO set up scaffolding so that students can complete tasks throughout the ZPD (with guidance) that can’t be resolved without guidance. Scaffolding is temporary, that is, when the ability of students has increased the scaffolding gradually discontinued, so that students can complete assignments independently.

Six major elements in the teaching process scaffolding, namely: (1) Establish a special purpose (sharing specific goal); (2) a comprehensive approach to the task (whole task approach); (3) Assistance is given on time (immediate availability of help); (4) Guidance directional (intention assisting); (5) Assistance at optimal level (the optimal level of help); (6) Setting up a model expert (conveying an expert model), the model expert can be prepared in an explicit example of task as experts to complete the task.

1.3. Teacher Training with Scaffolding Strategy

Scaffolding strategy has been used in teacher training program within few decade. One model of scaffolding in teacher training was Smith et. al (2013) model [10]. It has three objectives: diagnosis, responsiveness, and handover to independence.

Strategy scaffolding on teacher training in this paper implemented by the teacher does it, the class does it, the group does it, and the individual does it. The pattern of these measures is presented in Figure 1.
Figure 1. Pattern use in Teacher Training with Scaffolding Strategy [7]

- The first step, trainer give troubleshooting steps (the teacher does it), not with material explanation. In his capacity as a trainer scaffolding learning MKO (the more knowledgeable other), that is, those who have more competence than the participants. MKO will develop participants to achieve their potential competence. The coach gives a true example of solving the problem.
- The second step, namely the class does it. At this stage the responsibility handed over to the class coach, the coach only acts as a companion and container participants' opinions. The results are evaluated and reflected the working class to control the absorption (understanding) of the participants. Evaluation work is intended to determine whether the work meets the standards prescribed or not. If according to the evaluation results turned out to work does not meet the standards then do a reflection about solving problems at once to correct his mistakes.
- The third step is the group does it, the task is given to small groups. Problem solving is done with intensive interaction and communication among members of the group. The group had trouble can ask for help coach. The work groups were evaluated and are reflected as a second step. Until this third step means that each participant has three times gain experience in solving the problem.
- The fourth step, is the individual does it. Each participant was given the task / problem to do / be solved individually. In the final step, participants are required to demonstrate more independent completion of its task. The ability of the participants in completing the task at this stage illustrates that the competence of participants has increased one level higher than before. It also means that the participant has reached its potential competence.

2. Experimental Method
Subjects in this study were high school chemistry teachers in Sumedang who are members of Congress Subject Teacher (MGMPs) High School Chemistry. Customized training activities with programs planned by MGMPs. Teacher training activities conducted on 6-7 May 2015, housed in one of the high schools in KabupatenSumedang. The number of teachers involved in training activities as many as 24 people consisting of 20 women and 4 men.

The method applied in this study using mixed methods. Selection of mixed methods, because there is a need to examine more deeply not only in terms of quantitative, but also qualitative side. In this research will reveal the circumstances on the ground as it should be. The study design used is the One Group Pre and Post Test.

Some of the instruments used in this study include:

(1). Pre and posttest to measure the ability of teachers in designing inquiry-based lab.
(2). Questionnaire attitude scale to determine the response of teachers to the implementation of the scaffolding type training.

3. Result and Discussion

3.1. Implementation of Scaffolding Strategy in Teacher Training

Implementation of teacher training type of scaffolding held over two days with 16 hours of training models (1 hour of training = 45 minutes). Earmarking time is based on the complexity of the material and understanding of the early participants. The material discussed in training tailored to the needs of participants who netted through a preliminary study. Table 1 illustrates the need for training materials.

| Components in a preliminary study | Components in Design Lab Capabilities | Training Materials needed |
|-----------------------------------|----------------------------------------|--------------------------|
| Understanding of Inquiry          | Curriculum Analysing                   | Understanding of inquiry-based Lab |
| Stages of inquiry-based lab       | Assess Contextual Phenomenon           | Characteristics of inquiry-based Practicum |
| The role of teachers in the lab   | Identify tools and materials           | Strategies to design inquiry-based lab |
| The learning experience provided to students | Develop procedures                   | How to evaluate lab |
| Reflection on the ability to design lab | Establish a steering question         |                          |
| Evaluate the lab                  | Evaluate the lab                       |                          |
| Expectations of training          |                                        |                          |

In accordance with the characteristics of the type of scaffolding training, training events are on task. In order for the participants to understand the material, not through the delivery of content, but through tasks that have been prepared. In the first step (the teacher does it) on any matter, the facilitator presents the expected goal after studying the tasks given. In addition, the facilitator provides techniques that can be performed by the participants in order to complete the task. Once is enough, then the next step is the class does it. Domination activeness of participants in the training started on this step. Discussions occur more live with their differences of opinion among the group at this stage. Discussions also occurred in the step group does it, in the respective groups occurred discussion in order to complete the task. The last step is the individual does it, here teachers working on each task based on their understanding of each stage.

3.2. Teachers Ability in Designing Inquiry-based Lab

The ability of teachers in designing lab examined included six abilities as measured from the change before and after the training type of scaffolding. The results of tests the ability of teachers in designing inquiry-based lab work can be seen in Table 2.

According to Table 2, it appears that the value of N-gain the ability of teachers in designing the lab generally increased with the medium category, except the ability to analyse the curriculum is still low category. The average value of the N-gain with the high category in two ability, i.e the ability to assess the phenomenon of contextual and prepare questions directional capability.

The results of observations made during the training appears that the teachers are mastering the ability to analyze the curriculum. Although there are differences in the curriculum used by SMA in Sumedang, but another workshop about curriculum undertaken by all members of the Chemistry
MGMPs very good. This is indicated by the data that teachers are able to analyze the core competence and basic competences contained in the curriculum of 2013.

Table 2: Increase of Teacher Ability to Design Inquiry-based Lab

| No. | Indicator                     | Mean Pretest | Mean Posttest | Gain | N-gain | Category   |
|-----|-------------------------------|--------------|---------------|------|--------|------------|
| 1   | Curriculum Analysing          | 2.7          | 2.8           | 0.1  | 0.2    | Low        |
| 2   | Assess Contextual Phenomenon  | 2.0          | 2.9           | 0.9  | 0.9    | High       |
| 3   | Identify tools and materials  | 2.6          | 2.9           | 0.3  | 0.6    | Moderate   |
| 4   | Develop procedures            | 2.1          | 2.4           | 0.3  | 0.7    | Moderate   |
| 5   | Establish steering questions  | 2.1          | 2.9           | 0.3  | 0.9    | High       |
| 6   | Evaluate the lab              | 2.4          | 2.6           | 0.2  | 0.3    | Moderate   |

The situation is the same as the previous study [6] there are many teachers who do not carry out lab work, especially that presents a contextual phenomenon, for various reasons. One of the efforts that the teachers were able to examine the contextual phenomenon is often read books, expand the horizons and get to know the neighborhood. The lack of mastery in chemical materials also affect the ability of teachers to assess contextual phenomenon.

3.3. Teacher responses against the type Scaffolding Training

Teacher training with scaffolding strategy was first conducted in the Chemistry MGMPs in Sumedang, but feedback from teachers who attended the training was very positive. This is shown by data from the analysis of questionnaires that were distributed to the trainees. Data analysis of the questionnaire are presented in Table 3.

Table 3: Percentage Responses to the Teacher Training

| No  | Statement         | Percentage of responses (%) | Criterion |
|-----|-------------------|-------------------------------|-----------|
| 1   | Statement of 1    | 75                            | Strong    |
| 2   | Statement of-2    | 84                            | Very strong |
| 3   | Statement of-3    | 85                            | Very strong |
| 4   | Statement of-4    | 80                            | Very strong |
| 5   | Statement of-5    | 86                            | Very strong |
| 6   | Statement of-6    | 75                            | Strong    |
| 7   | Statement of-7    | 81                            | Very strong |
| 8   | Statement of-8    | 75                            | Strong    |
| 9   | Statement of-9    | 88                            | Very strong |
| 10  | Statement of-10   | 75                            | Strong    |
| 11  | Statement of-11   | 75                            | Strong    |
| 12  | Statement of-12   | 75                            | Strong    |
| 13  | Statement of-13   | 80                            | Strong    |
| 14  | Statement of-14   | 75                            | Strong    |
| 15  | Statement of-15   | 83                            | Very strong |
| 16  | Statement of-16   | 75                            | Strong    |
| 17  | Statement of-17   | 75                            | Strong    |
| 18  | Statement of-18   | 75                            | Strong    |
| 19  | Statement of-19   | 75                            | Strong    |
| 20  | Statement of-20   | 75                            | Strong    |
| 21  | Statement of-21   | 75                            | Strong    |
| 22  | Statement of-22   | 86                            | Very strong |
| 23  | Statement of-23   | 83                            | Very strong |
| 24  | Statement of-24   | 83                            | Very strong |
Based on Table 3 it can be observed that the scaffolding type training is done to get a positive response from the participants. This is evident in the percentage criteria of teacher responses after training showed strong and very strong criteria. On the last topic, which is the follow-up training of teachers is very strong response. This means that the teachers are very confident to be able to implement the results of in-class training.

4. Conclusion
In this paper, we have reported the development of Chemistry teacher’s ability to design inquiry-based lab through Scaffolding type of teacher training. Six teacher’s ability to design inquiry-based lab has increased after training, with two abilities were attained highest gain. Moreover, the teacher training with scaffolding strategy was responded positively.

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