

# Effectiveness of Problem Based-Assisted Instruction Student Worksheet Guided-Inquiry-Based Learning in Chemistry

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**Abstract.** This study aims to determine the effectiveness of problem-based learning-instruction-aided student worksheets based guided-inquiry in learning chemistry. This study was an experimental study. The study design using posttest only control group design. Treatment group and control group is selected by cluster random sampling. The population in this study is a class XI student of a school in a city in Central Java. Data were collected by documentation, observation, testing, and questionnaires. Learning outcomes measured in this study include knowledge, attitudes, and skills. Posttest results of data analysis showed that the treatment group classical completeness of 82.86% and the control group of 58.33%. Results of votes on the attitude of the treatment group of higher-class control while being polite treatment group lower than the control group. Skills treatment group is higher than the control group in all aspects. Therefore, the problem based learning-instruction-aided student worksheets based guided inquiry learning is less effective in chemistry.

**Keywords:** guided inquiry; classical completeness; problem based-instruction

## 1. Introduction

Chemistry is a difficult subject according to the students. They are not able to understand the concepts being taught by a teacher or learning from books. Chemicals, which has a relationship with the students' daily life practice cannot connect the concept of life. This led to a growing number of students have difficulty with chemistry lessons.

Observations were conducted in December 2015-January 2016 in four schools, in Central Java shows that three of the four schools have problems in learning the material hydrolysis, solubility and solubility product, student learning outcomes were still low. The problem is particularly marked in a school indicating that students had difficulty in learning the material, especially chemical hydrolysis, solubility and solubility product both in studying the concept of reaction and in connect concepts with everyday life. Students prefer to receive the material identified by the teacher so that the learning process is quite passive. The correlation between the material to everyday life also has not been applied with the maximum in the learning process. Chemistry student learning outcomes in subjects hydrolysis material chemistry, solubility and solubility product showed that only 60% of students who reached the minimum completeness criteria (KKM).

Problem-based instruction is a learning model that presents a problem to the students before the students build knowledge [1]. Problem based-instruction is effective used in learning process [2]. Problems given to the students in the learning process will stimulate students to think about how to solve it. Teachers play a role in asking the problem, facilitating student inquiry and dialogue and to support student learning [3]. Sintaks problem based learning -instruction used in this study adopts from Arends [4] as follows: (1) Orienting the students on the problem, (2) organize students to research, (3) help students solve problems, (4) Develop and present the results of solving the problem, (5) Analyze and evaluate the problem-solving process.

The learning process requires tools for the implementation easier, both teachers and students. One of these tools is the student worksheet. The worksheet is needed in problem-based learning -instruction are worksheets that guide students to learn independently in solving problems and finding new concepts. Problem -based -instruction take students on the proceedings [5]. Guided inquiry leads students to think for student-centered learning where students are not only taught by teachers [6]. Guided inquiry makes learning more controlled because students receive guidance from teachers in solving problems [7].

The purpose of this study was to determine the effectiveness of problem-based learning -instruction-aided student worksheets based guided inquiry to the learning outcomes of students in the material hydrolysis, solubility and solubility product. Criteria for effectiveness include: (1) aspects of knowledge which meets the classical completeness  $\geq 85$  % of students reached the KKM is 75 (2) aspects of the attitudes of students in at least 80 % reach the criterion of good and excellent (3) aspects of the student's skills in practical activities at least of 80 % of students reached the criteria of good and very good.

The population in this study is a class XI MIPA 1-7 in a school in the academic year 2015/2016. Sampling using random cluster sampling technique and obtained a Grade XI MIPA 5 and MIPA 4 respectively as the treatment group and control group. Treatment consists of 35 students and control group consists of 36 students. Variable in this research is a learning model. Treatment group using problem based-instruction using student worksheets based guided inquiry and the control group using a model of problem based-instruction. The dependent variable is the result of student learning. While the control variables are the teachers, the number of lessons available and the curriculum used. The study design used is a post-test only control group design.

Data collection techniques using three methods: the method of documentation, observation, testing, and questionnaires [8]. Documentation is made to retrieve a list of student names and data UAS one semester. Observation is used in measuring the attitudes and skills performed by three observers. The test is used to measure the knowledge that at the end of learning. The questionnaire used to determine the response of students to the learning that has been implemented.

Population data analysis used data UAS value of one semester. This analysis includes the normality test, homogeneity and equality test average. Normality test using chi square test and homogeneity test using Bartlett test. Normality and homogeneity test is used as a condition for sampling with random cluster sampling technique. Average equality test is used to determine whether an treatment group and control group have the same average or not so that can know the changes that occur in each of these classes after being given a different treatment.

Analysis of the final stage is used to answer the hypothesis put forward in this study. This analysis was conducted on the post test results of the test includes testing the thoroughness of learning outcomes. Analysis of attitudes and skills using descriptive analysis. Such attitudes are analyzed every aspect to find out which aspects are already owned by the student and which aspects need to be developed. Skills are analyzed every aspect includes preparation, when practical, and after the experiment. Analysis of the questionnaire responses of students using descriptive analysis. This analysis is used to determine how the students respond to the problem based learning -instruction-aided student worksheets based guided inquiry. Student feedback questionnaire given at the end classes after posttest.

## 2. Result and Discussion

Student learning outcomes measured in this study consists of knowledge, attitudes, and skills in material hydrolysis, solubility and solubility product. Aspects of the knowledge gained from post-test at the end of the lesson in the form of multiple choice questions of 30 questions. Details of the data post test experimental classes and control groups are presented in Table 1.

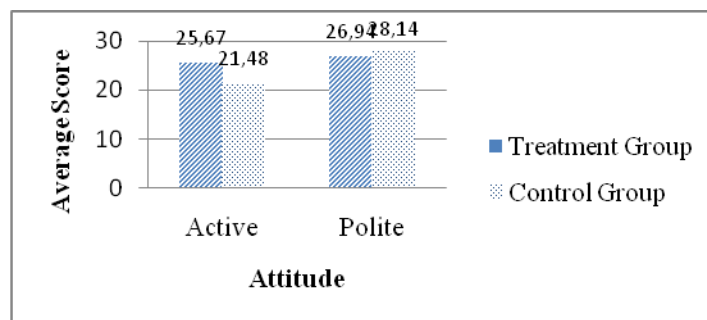
Table 1. Data Analysis Post Test

Component	Treatment Group	Control Group
Average	82,2	76,31
Completeness students	29	23
Classical Completeness	82,86 %	58,33 %

Analysis mastery learning outcomes classical completeness is used to determine the treatment group and control group. Classical completeness the treatment group and control group is 82.8 % and the thoroughness of the control group of 58.33 %. Classical completeness achieved when as much as 85 % reached the limit of minimum completeness. It means that both the treatment group and the control group did not reach the classical completeness. This is not in accordance with the opinion of Fatmasary [9] that suggests that student worksheets based guided inquiry can improve learning outcomes and classical completeness. This result is due to the implementation of the study was not

conducted as planned. In addition, the material is taken on the learning material digestive system in biology. So guided inquiry is not effectively applied to all the material.

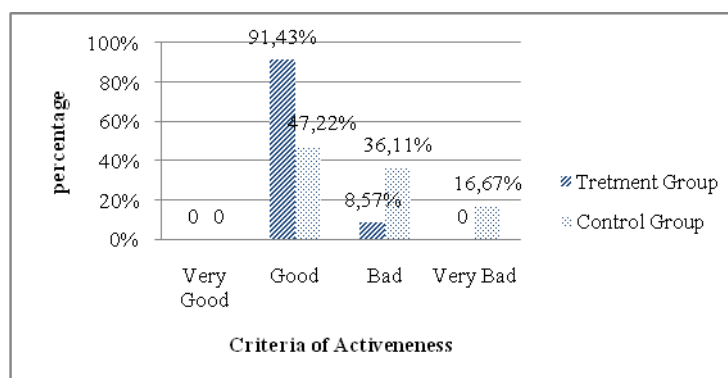
The attitude of the students is measured by observation by three observers. Attitudes are assessed in this study consisted of two aspects active and polite. Ratings attitude made during learning in the classroom is when discussions. Active attitude and manners treatment group is higher than the control group. Comparison of average yield affective treatment group and control group is presented in Figure 1.



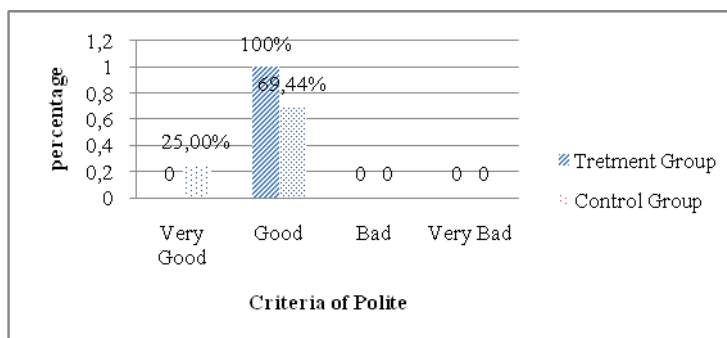
**Figure 1.** Comparison of Average Rate Attitude

Active attitude in the treatment group had an average score of 25.67 and an average score of control group is 21.48. Students in the treatment group have high activeness during the learning. Each of the students ask questions when doing group discussions, both towards other students or teachers. This is in accordance with the opinion of Vlassi and Karaliota [10] that guided inquiry learning increases student activity in the learning process. Students in the control group tend to be passive compared to the treatment group, not a lot of questions or answers submitted. Other research showed that problem based-instruction give the opportunity for students who can actively involve in their learning [11].

Politeness treatment group lower than the control group. The average score of 26.94 treatment group and control group average of 28.14. Politeness views of how students submit responses and questions as well as respect for others who are talking. Students in the treatment group cannot control themselves when it spoke, they did not listen quietly when the teacher or another student was giving an explanation. Students in grade control more coherently convey responses or questions. They also pay attention to the teacher and other students while talking. The results of students' attitude measurement criteria are grouped into very good, good, bad, and very bad. The percentage of each criterion are presented in Figure 2 and Figure 3.

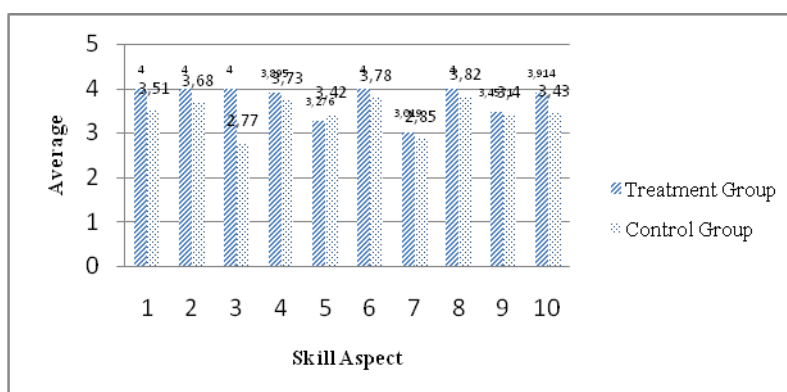


**Figure 2.** Result of Activeness



**Figure 3.** Result of Activeness

Based on figure 2 and figure 3 is known that the active attitude of students in the treatment group with a good criterion of 91.43%. Politeness treatment group with a good criterion of 100%. This means that an active attitude and manners the treatment group reaches 80%. Skills assessment conducted to determine differences in activity and physical abilities graders experimental and control groups during the learning process takes place. Skills assessment done at the first meeting when hydrolysis experiment. Skills were assessed at practical activities hydrolysis. It consists of 10 aspects include activities prior to the lab, when the current lab activity, and after the practicum. The average result of learning psychomotor treatment group and control group is presented in Figure 4.

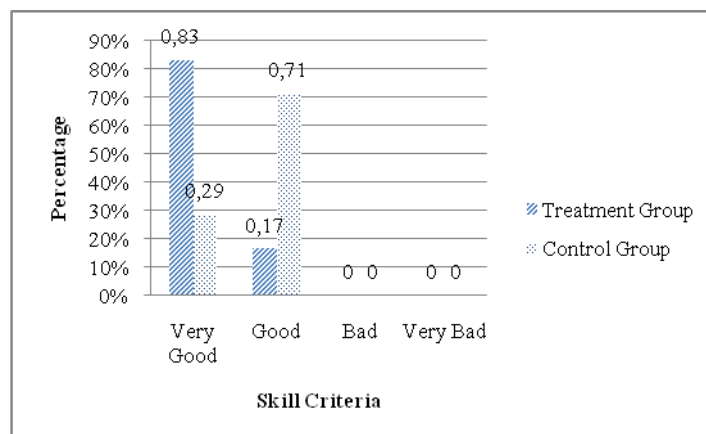


**Figure 4.** Comparison of average Skills

Information:

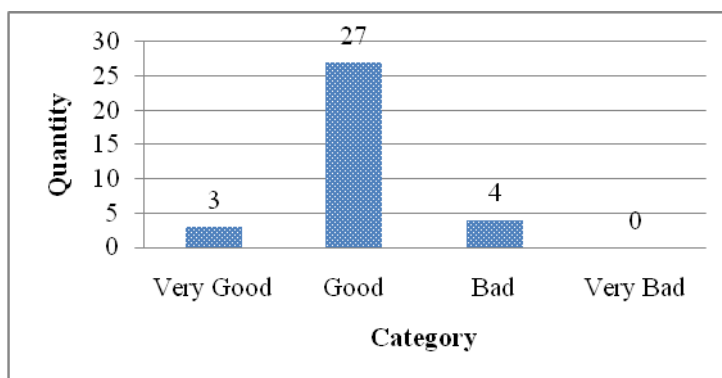
1. Preparing the lab tool
2. Prepare a working solution
3. Setting up a temporary report format
4. Skills Using a pipette
5. Skills measure volume of solution
6. Skills reacting a working solution
7. Cleanliness and neatness of the table as a practicum
8. Create a report interim analysis results
9. Hygiene tools and a practicum
10. Make practical reports individually

Skills of treatment group is higher than the control group in all aspects. This happens because the students in the treatment group to think systematically based syntax that is in the student worksheet - based guided inquiry. This is in accordance with the opinion of Douglas and Chiu [7] that the guided inquiry learning students think and feel that learning is theirs because of student-centered learning. Similarly, the assessment, skill assessment criteria are grouped into very good, good, bad, and very bad. Skills in the treatment group got a criterion of good and very good. This means that the skills of the students in the treatment group achieve effectiveness criteria. The percentage of skill assessment criteria are presented in Figure 5.



**Figure 5.** Percentage Criteria Skills

Questionnaire responses are given at the end of learning students in the treatment group. Recapitulation responses student questionnaire is presented in Figure 6



**Figure 6.** Results of Student Questionnaire Responses

Analysis of the questionnaire responses of students indicate that students have responded positively to the learning problem based-instruction-aided student worksheets based guided inquiry on the matter hydrolysis, solubility and solubility product. In filling the questionnaire there was one student who was not consistent in answering the question, it is seen from the statement could not agree on all the statements there, but there are statements made by the negative sentence. Therefore, the questionnaire analysis is only done on 34 students who answered with examining the existing every statement. A total of 3 students responded very well to learning problem based-instruction-aided student worksheets based guided inquiry on the matter hydrolysis, solubility and solubility product, 27 students gave responses good, 4 students respond less and nothing gives responses very less. So overall the students give feedback that problem based learning model-aided instruction student worksheets based guided inquiry is best applied in chemical materials learning hydrolysis, solubility and solubility product.

### Conclusion

Based on the analysis and explanation can be concluded that the problem assisted-instruction-aided student worksheets based guided inquiry learning is less effective in materials chemistry hydrolysis, solubility and solubility product

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