# The Influence of Orientation/Develop/Do/Discuss/Reflect (OD3R) Method on Students' Writing Skills and Scientific Attitudes in Biochemistry Laboratory Course

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**Abstract.** This study aims to examine the influence of implementing the Orientation/Develop/Do/Discuss/Reflect (OD3R) method to influence the students' report writing skills and scientific attitudes in biochemistry laboratory work. The laboratory work report writing skills are seen based on the modification of the Hoyo rubric. The components assessed include abstracts, information sources, organization, relevance, content, and presentation. Scientific attitudes are measured using a questionnaire with categories of attitudes such as curiosity, open-mindedness, objectivity, honesty, responsibility, and mutual respect. The study used post test only control group design with 41 undergraduate chemistry students as the respondents. There are 21 students in control group and 20 students in the experimental group. The influence of OD3R method towards the two variables was tested using MANOVA. The results show that the OD3R method was able to influence the laboratory work report writing skills and the students' scientific attitudes.

**Keywords:** Active learning; scientific attitudes; writing skills.

## 1 Introduction

Biochemistry learning will be easily understood if it can be connected with the macroscopic, sub-microscopic, and symbolic levels [1]. However, in reality, learning biochemistry becomes difficult for students to understand because of the complex materials and the inability to connect macroscopic, microscopic, and symbolic levels [2]. Irrelevant explanations to the students' lives lead to the students' low interest and motivation towards biochemistry [3-6].

Laboratory work is one of the methods that can connect the three macro, micro, and symbolic levels [7]. Learning in laboratory to be effective if the topic practiced is integrated

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with the theories learned in the class [8]. Besides being integrated, the use of expository method does not dominate so that it can train the students' analytical skills [9,10].

In Indonesia, the use of the expository method still dominates the implementation of laboratory work in biochemistry subject [11]. This method prioritizes the processing and data interpretation stages and does not involve students in designing the investigation process. Some universities in Mataram have not integrated classroom theory and laboratory work [12]. Since the implementation of the KKNI curriculum in Indonesia, the implementation of learning is expected to be able to integrate the cognitive, psychomotor, and affective domains [13]. The integration does not only cover the classroom learning and the laboratory work implementation, but the assessment process as well.

The OD3R method was developed to be able to integrate theories and laboratory work as well as to reduce the use of expository method [14]. The OD3R method consists of 5 stages by including the stages of designing investigation that were not previously given in traditional laboratory work. In addition, this method uses laboratory work report writing skills as the cognitive assessment. However, the influence of modification to this method not been tested for writing skills and scientific attitudes.

Writing skills are important things that need to be trained in chemistry students. Through writing, students can practice their critical thinking skills, effective communication skills and make sense of new knowledge and ideas [15,16]. In addition, writing skills can strengthen students' cognitive domain and can help students develop a better understanding of core ideas of science [17,18].

Laboratory work report is a tool that can be used to train students' writing skills. However, writing traditional laboratory reports currently have more weaknesses. This technique only duplicates laboratory work instructions without thinking, and gives less feedback on reports that have been prepared by students [19]. Feedback is an important part of being able to train students to make good and systematic reports [17,20-22].

Assessment of laboratory work reports can be done using the assessment rubric. Hoyo [23] developed a rubric that can be used to assess the chemistry students' laboratory work reports. Components assessed are abstract, information sources, organization, relevance, content, and presentation. Greenberg [24] developed simpler rubric, covering content, expression, and formatting. This study uses the rubric from Hoyo [23] which has been modified to assess the students' laboratory work reports.

Scientific attitudes are certain attitudes that the scientists need to develop to carry out scientific processes [25]. The scientific attitudes show open-mindedness, honesty, and is oriented in the experiment to find the truth [26,27]. The scientific attitudes referred to in this study is the unity of process and critical thinking skills that are shown in conscious behavior. The categories used are curiosity, open-mindedness, objectivity, honesty, responsibility, and mutual respect [28].

This study aims to examine the influence of implementing the Orientation/Develop/Do/Discuss/Reflect (OD3R) method to improve the students' report writing skills and scientific attitudes in biochemistry laboratory work.

## 2 Method

### 2.1 Participants

Participants of this research were undergraduate chemistry students batch 2015/2016 who took Biochemistry subject in Universitas Mataram. The study used post test only control group design with 41 undergraduate chemistry students as the respondents. There are 21 students in control group and 20 students in the experimental group.

### 2.2 Implementation of OD3R Method

In Biochemistry laboratory work, students performed 6 experiments in 16 week semester. The experiment topics included carbohydrate and lipid. Implementation of OD3R method is applied in experimental group and students were expected to complete the experiments in the allotted 2 hours laboratory time. Control group implemented expository lab work with the experiment topics were same in the experimental group. Each group held a 4 teaching assistants who observe and providing assessment on the laboratory work writing. Before conducting an assessment, teaching assistants are given a workshop on how to use the assessment instrument and how to give an assessment. The structure of the OD3R method used in the study is shown in Table 2.

**Table 2** . The structure of OD3R method (Modified from Anwar et al., [14])

| Stage | Scenario |
|---|---|
| Orientation (O) | a. Lecturer explains competency, lesson activity, and evaluation technique<br>b. Lecturer explains initial discussion briefly<br>c. Group discussion of the given material<br>d. Presentation to discuss the main discussion<br>e. Instruction to discuss preparation to stage 2 of learning |
| Develop (D) | a. Lecturer gives the students a task to design experimental plan using agreed limitations.<br>b. Presentation of initial design.<br>c. Laboratory work design revision |
| Do (D) | a. Students do laboratory work according to the final design resulted from the discussion.<br>b. Taking notes of the laboratory investigation in the form of a temporary report. |
| Discuss (D) | a. Students write laboratory work report individually<br>b. Group presentation of investigation result<br>c. Lecturer gives feedback on students' presentations and reports<br>d. Students revise reports |
| Reflect (R) | a. Review of the material using article related to the topic and surrounding environment<br>b. Class discussion |

### 2.3 Research Instruments

This study used 2 types of instruments, namely writing skills rubric and scientific attitudes questionnaire. The laboratory work report writing skills assessment used a

modification of Hoyo rubric [23]. The components of the laboratory work report that were measured included abstracts, information sources, organization, relevance, content and presentation. Cognitive abilities measured following the Bloom's taxonomy namely synthesis, knowledge and evaluation, analysis, knowledge and application, understanding, and evaluation. Each component of the report was scored on a scale of 1 to 4 according to the criteria developed.

The scientific attitudes used in this study followed the 2014 KKNI curriculum definition as part of character education in Indonesia. The categories of scientific attitudes that were measured were curiosity, open-mindedness, objectivity, honesty, responsibility, and mutual respect [28].

The content validity of the laboratory work writing skills rubric and scientific attitudes questionnaire were measured through the expert agreement index [30]. A total of three chemistry education experts were asked to assess the instruments. The assessment results of the three experts were tabulated and calculated to find out the Aiken index of each category [31]. The calculation of the Aiken index showed that the three instruments had fairly good validity. The Aiken index of laboratory work writing skills rubric and scientific attitudes questionnaire were 0.72 and 0.81 respectively.

Instrument reliability was measured using the ICC with the help of SPSS 21 because there were more than two raters. The ICC calculation showed that the value for the laboratory work writing skills rubric and scientific attitudes questionnaire were 0.867 and 0.864 respectively. The ICC value showed that the instruments were reliable [32].

### 2.5 Data Analysis

The influence of applying the OD3R method on writing skills and scientific attitudes was tested using one way Multivariate Analysis of Variance (MANOVA) with SPSS 21 (IBM SPSS Statistic 21). The OD3R method had an influence towards the two dependent variables if the value is $p < 0.05$.

## 3 Results

The writing skills revealed a mean score of 75.31 (SD = 4.38) at the implementation of OD3R method and a mean score of 64.00 (SD = 6.2) at the expository method (Figure 1). All components of biochemistry laboratory work report such as abstract, source information, organization, relevance, content, and presentation showed higher score in experimental group than control group. The content is the component of laboratory work report which has the lowest value in both of group, while the presentation is the component which has the higher value.

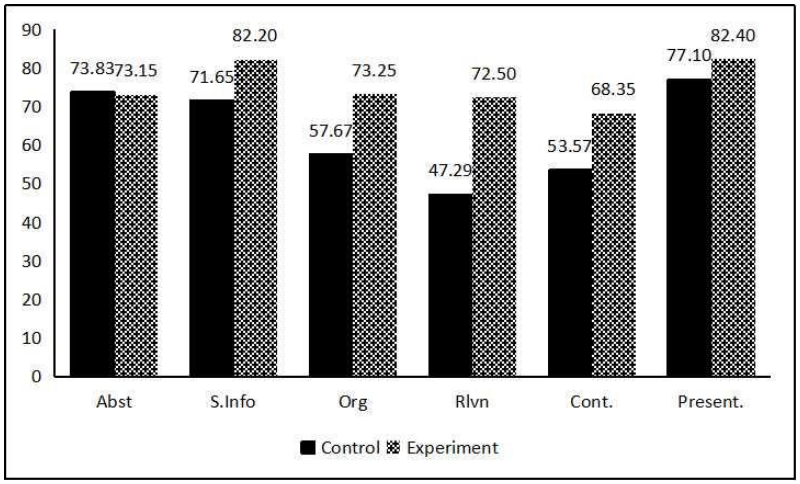


**Fig. 1.** The effect of OD3R method toward writing skills

The scientific attitudes in experimental group have better score than control group. Scientific attitudes score in experimental and control group were 87.22 (SD = 1.67) and 72.96 (SD = 2.66) respectively. All attitude categories showed the highest average score in group that implemented OD3R method (Figure 2).

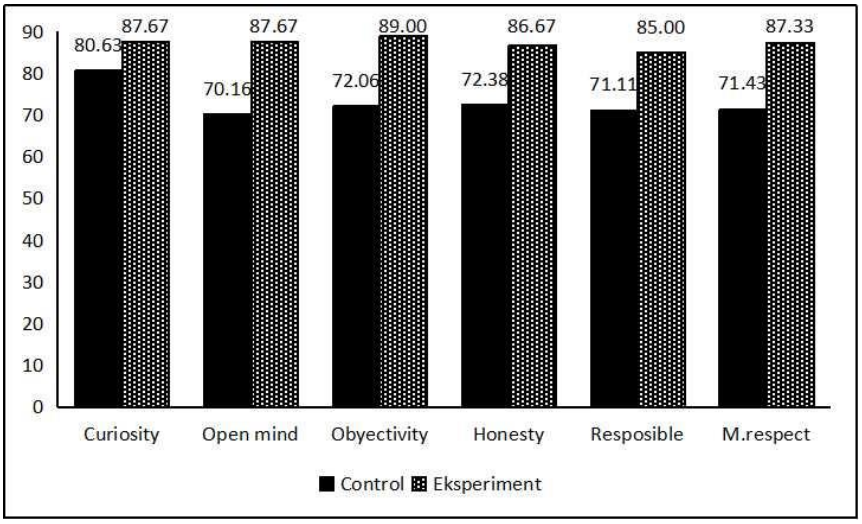


**Fig. 2.** The effect of OD3R method toward scientific attitude

The test between subject effects evaluates the influence of implementing the OD3R method towards the two dependent variables. Before testing, MANOVA assumption was tested using Levene test for the two dependent variables. The results of the Levene test shows $p > 0.05$, which means that the variance is the same and in accordance with the MANOVA

assumption [33]. The MANOVA test results show that the implementation of the OD3R method had a significant influence towards the laboratory work writing skills and scientific attitudes ($p$ <0.05).

## 4 Discussion

The research results showed that the implementation of the OD3R method to the biochemistry laboratory work affected the students' laboratory work writing skills and scientific attitudes. The student's skill in writing an laboratory work report actually shows the students' ability to practice cognitive abilities. In control group that implemented expository method, almost all report components show low score. This shows that students have not been able to understand, explore knowledge, analyze, and synthesize the topics they wrote in the report. Wackerly's research [22] reports that the students' ability to write is a complex thing to understand so that it requires a gradual approach in improving the students' writing skills. Through the laboratory work report, chemistry students can be trained gradually to have good writing skills [20,34]. However, expository laboratory did not an opportunity to students to develop many skills [9].

The components of the laboratory work report with the lowest values in experimental and control groups were abstract, relevance, and context. Abstract shows the students' ability to synthesize the introduction to the conclusion of a writing. Students assume that composing abstracts has similarities with composing conclusions and summaries. Similarly, Gupta [35] and Hoyo [23] reported that chemistry students often experience difficulties in composing the abstract. Wackerly [22] reports that composing abstract is the most complex component after composing conclusions.

Relevance shows the students' ability to integrate theories and implementation as well as learning activities in the classroom. This component is a component with a low score. Students are less able to provide a good discussion. In line with the research reported by Wackerly [22] and Anwar *et al*. [14] that composing discussion is a complex part of the inquiry report. This component has the lowest value compared to other components in the laboratory work report [24].

Content shows students' understanding towards what they write in the laboratory work report. In line with this study, Gupta [35] and Greenberg [24] reported that the content component was the lowest rated component compared to other laboratory work report components. Anwar *et al*. [14] reported that students were less able to compose laboratory work reports in their own language, indicating that they did not understand what they wrote.

The implementation of the OD3R method influence the students' ability to compose laboratory work reports. The orientation stage trains students to learn to connect theories learned with the topic of the laboratory work. This stage can increase students' interest and motivation to remember the content in the long term [36,37]. In the next stage, students are asked to design an investigation plan that is able to help students connect laboratory work and theories in classroom when they compose the discussion part in the laboratory work report [38,39]. The OD3R method not only helps students integrate laboratory work and theories in classroom but also provides feedback from reports prepared by the students. Feedback given to students on laboratory work reports helps students to produce better laboratory work reports [20,21,34].

Scientific attitudes have a variable that is influenced by the implementation of the OD3R method. The six categories of attitudes are important things that can be trained through laboratory work. The scientific attitudes that are trained in students are reported to be able to influence the students' psychomotor abilities because human emotions are not limited to only one area of the brain. Attitudes can influence the students' psychomotor abilities in learning that involves laboratory work [40,41].

## 5 Conclusion

The implementation of the OD3R method has an influence towards the students' writing skills and scientific attitudes in the biochemistry laboratory work. All components of biochemistry laboratory work report and scientific attitudes showed higher score in experimental group than control group.

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