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Research Article

# Collaborative Skill Improvement Analysis in Real Laboratories Based on Discovery Learning for Undergraduate Physics Education Major

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**Abstract.**
The 21st-century competencies are needed as provisions for college graduates to face the era of society 5.0. These competencies include creative thinking skills, critical thinking, collaboration, and communication. The research aims to illustrate the influence of discovery learning on students' collaboration skills during real laboratory activities. Discovery learning was chosen because the implementation of practicum activities was carried out in a real laboratory because it requires all the students to play an active role and be able to collaborate in carrying out practicum activities. This type of study uses one pretest-posttest design group. The subject of this study was 30 first-year students from two different classes who took the Basic Physics Practicum II course at the Department of Physics Education, UIN Sunan Gunung Djati Bandung. The implementation of practicum activities is carried out offline so that cooperation and collaboration between groups can be seen. Aspects of the indicator include positive dependence between members, individual responsibilities, group cooperation, and face-to-face interaction. Research data was processed statiscally using the help of SPSS software version 25. Analysis of research results showed that student collaboration skills were complete and appropriate in all indicators. Based on the analysis, an average N-Gain score of 53.2% was obtained with the category being in the criteria for improving collaboration skills.

**Keywords:** collaborative skill, real laboratory, discovery learning

## 1. INTRODUCTION

Education has an important role to create human resources that can face challenges in the era of the industrial revolution 4.0, namely through 21st century learning. Learning in the 21st century or familiarly called "4Cs" includes the following aspects 1) critical thinking skills, 2) creative and innovative thinking skills, 3) communication skills, 4)

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collaboration skills [1]. One aspect that will be discussed in this study is the aspect of collaboration skills. collaboration is equivalent to working effectively with others both individually and in groups with the aim of solving the problem being studied [2, 3]. Through collaboration, students can grow awareness of social interactions, develop self-confidence and add learning experiences as an effort to realize meaningful learning and require students to work in teams with different characteristics of group members [4, 5].

The component aspects that focus on improving collaboration skills are: 1) positive interdependence, 2) interaction in groups, 3) communication, 4) accountability and personal responsibility of individuals, and 5) cooperative skills [2, 6–8]. Collaboration in learning is very important because students can work together in differences as provisions to face the era of globalization in the 21st century, by collaborating can also increase the mastery of student concepts so that they can help students to achieve quality final results.

One of the learning practices that can apply 21st century skills, especially in the aspect of collaboration skills, is through practical activities in the real-laboratory. Practicum activities in the laboratory can train students to be actively involved in the process of observing, analyzing, proving and concluding about objects or some other process through a small group [9]. As a practicum activity, students are faced with scientific problems so that they are required to be able to solve these scientific problems independently and in groups. Therefore, practicum activities, especially real laboratory activities must be supported by the right approach, methods, and learning models so that activities are more targeted and structured and able to direct learners to understand materials and find new concepts in learning [10].

The learning model used in this study is the discovery learning model. Discovery learning is a learning model that gives learners the opportunity to learn to find and find their own solutions to the problems at hand [11, 12]. In this case, real laboratory practicum activities that demand collaboration skills competencies by using discovery learning models provide opportunities for students to be able to find broad learning resources for practicum materials that are being studied. The steps of discovery learning are not much different from practicum learning in the laboratory, namely by facilitating the stages of stimulation, problem identification, data collection, data processing, verification and generalization or conclusion [13, 14].

Some relevant research that discusses collaboration skills using discovery learning models during real laboratory activities are research conducted by [7, 13]. These studies

showed a positive influence on improving collaboration skills using discovery learning models during real laboratory activities.

## 2. RESEARCH METHOD

The research method used is a quantitative descriptive method by using a one group pre-post design research design as a test to collect data accurately. In addition, the collection of research data is strengthened by using student response questionnaires based on the rubric of collaboration assessment. Filling the questionnaire sheet is carried out as many as two stages, namely pre-posttest and student response questionnaire. The pre-posttest was carried out with the aim of knowing the level of motivation for collaborating skills using discovery learning models during real laboratory activities [15]. The student response questionnaire sheet aims to observe student activities during real laboratory activities by giving each other assessments of their groupmates.

The discovery learning syntax used during real laboratory activities is divided into 2 stages, namely the preliminary stage and the practicum stage. In the preliminary stage will begin with preliminary activities, stimulation, and problem statements. Later at the stage of problem statement students will be given a pretest to be able to see preliminary knowledge about practicum activities. Furthermore, the practicum stage is filled with real laboratory activities that include data collection, data processing to verification data [15]. During the practicum activity, there will be a student response questionnaire sheet that will be filled out by each student in accordance with their respective groups. And at the end will be given a posttest to see the final results of real laboratory activities during the group's activities.

The subjects of this study were 30 first-year students of the class of 2021/2022 from two different classes who participated in the Basic Physics Practicum II course at the Department of Physics Education UIN Sunan Gunung Djati Bandung. The implementation of practicum activities is carried out offline so that cooperation and collaboration between groups can be seen. The aspects of indicators used as references in research are aspects of positive dependence between members, individual responsibilities, group cooperation, and face-to-face interaction [2].

Later the pretest and posttest values are calculated using the following formula [16].

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \times 100\% (1)$$

The calculation results above are converted into qualitative values according to the N-Gain value assessment criteria as follows.

Table 1: NGain score criteria.

| N-Gain Score | Criterion |
|---|---|
| > 0.7 | Tall |
| 0.3 < N-Gain < 0.7 | Keep |
| N Gain < 0.3 | Low |

Furthermore, the research data was statistically processed using the SPSS version 25 software. The data analysis technique was carried out using the normality test and homogeneity test to test the sample, while the t-test was used to test the hypothesis. After processing the data, an analysis of the N-Gain value was carried out to obtain normality, homogeneity, and the difference between the two average collaboration skills data while using the discovery learning model from the two research class samples. The normality of the data was tested through the Shapiro-Wilk Test with a significant level > 0.05. The homogeneity of the data was tested by Levene's test with a significant level > 0.05. The two-average difference test was carried out with an independent sample t-test of the average N-Gain value of collaboration skills during real laboratory activities.

As for determining the percentage in the aspect of collaboration skills assessment is as follows.

$$X = \frac{\sum_{Score}}{\sum_{SMax}} \times 100\% (2)$$

The results of the percentage calculation will be converted into qualitative values according to the criteria for range and assessment of collaboration skills as follows [8].

Table 2: Score range and collaboration skills assessment.

| Score Range | Criterion |
|---|---|
| 22% – 37.5% | Low |
| 38.5% – 54% | Keep |
| 55% – 70.5% | Tall |
| 71.5% – 88% | Very High |

## 3. RESULTS & DISCUSSIONS

Collaboration skills measured in this study include collaboration skills indicators according to [17] adopting collaboration skills indicators from [2] research . The collaboration

skills indicator consists of several indicators, namely effective group cooperation, group cooperation with diverse teams, contributing individuals made by each team member, adapting fellow team members, being jointly responsible for joint work, compromising to achieve common goals and deliberating in making decisions, communicating effectively in groups.

The results of the analysis of pretest and posttest values during real laboratory activities are shown by Figure 1.

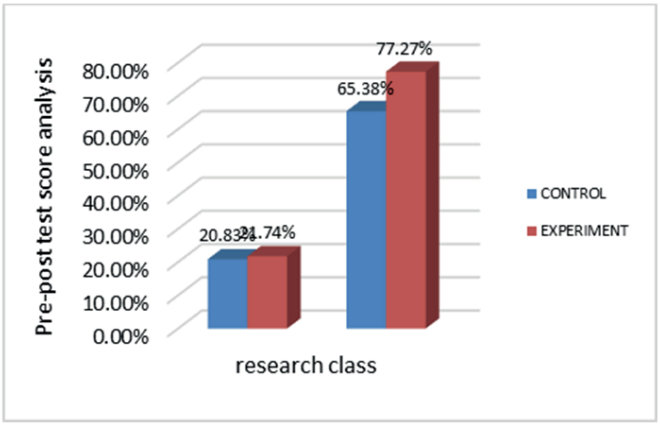


**Figure** 1: Results of pre-posttest value analysis in control classes and experiments.

Pretest scores in control and experimental classes were not much different from changes, namely 20.83% for the control class and 21.74% for the experimental class. While the posttest value obtained a significant value of 65.38% for the control class and 77.27% for the experimental class with a range of difference between two class is 11.89%. During the pretest the activities of the real laboratory are carried out without any meaningful treatment. Then during the process of practicum activities used discovery learning learning models given in experimental classes only.

Furthermore, hypothesis testing was conducted again using the results of the N-Gain score test to determine the significant differences in the research class of both the control class and the experimental class. Based on the results of the analysis using the help of SPSS software version 25 shown in Figure 2.

In Figure 2 it is clearly seen that the difference in the average N-Gain score between the control class and the experimental class is not much different from N-Gain score in the “medium” category. Although in the same category, but in the experimental class can be seen a fairly slightly significant change indicated by the posttest results shown in Figure 1.

In addition to using pretest and posttest scores, students also filled out student response questionnaire sheets that were disseminated periodically during the last real

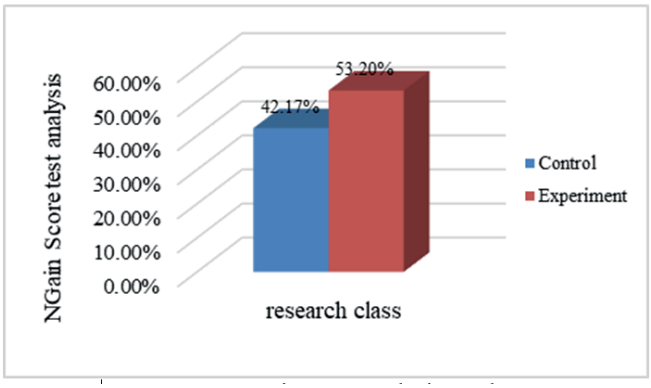


**Figure** 2: N-Gain score analysis results.

laboratory activities in the second week. The real laboratory activities are carried out for 2 weeks because students must collect practicum reports as a result of practicum activities. Scores on the collaboration skills assessment questionnaire using the assessment rubric according to the existing score range. The results of the distribution of response questionnaires in control classes and experimental classes can be seen in Figure 3.

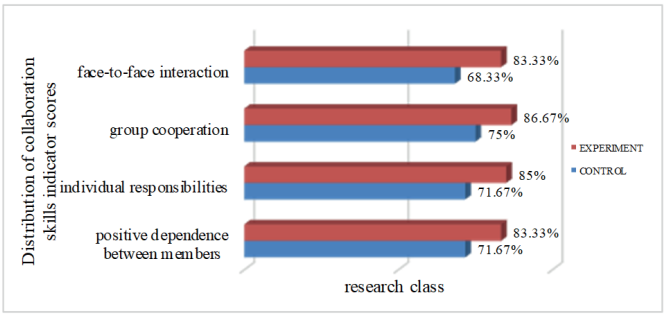


**Figure** 3: Results of the analysis of indicators of aspects of collaboration skills.

In Figure 3 there are four indicators of collaboration skills, namely face-to-face interaction, group cooperation, individual responsibility, and positive dependence between members. In each study results, there is a significan difference with each indicator of the score range obtained is not much different. In the indicator of face-to-face interaction obtained results in the control class is 68.33% and the experimental class 83.33% with a percentage difference of 15%. In this indicator, students respond to face-to-face interaction during real laboratory activities. Some student responses gave a fairly motivated response with the division of practicum groups. However, there are some who are less active because they do not understand practicum material so as to inhibit active interaction between groups.

Furthermore, the group cooperation indicator obtained results in the control class, which is 75% and the experimental class is 86.67% with a percentage difference of 11.68%. In the group cooperation indicator, all students are required to participate in

collaborating in solving problems during real laboratory activities. Although not all groups really work together, because there are some groups that cannot complete their practicum on time. But overall based on the questionnaire of student responses all gave a good response to the members of the group without burdening one and the other.

In the indicator of individual responsibility obtained results in the control class is 71.67% and the experimental class 85% with a percentage difference of 13.33%. In the indicator of individual responsibility, all students cooperate with each other by doing individual tasks. Each of these tasks includes data collection, data processing, data calculation and analysis which will later be reported in each group's practicum report. During the real laboratory activities take place all groups can well perform their individual responsibilities without burdening one or the other.

Then in the indicator of positive dependence between members obtained results in the control class is 71.67% and experimental class by 83.33% with a percentage difference of 11.66%. In the indicator of positive dependence between members is not to charge all tasks during real laboratory activities on certain members only. But cooperate with each other and coordinate to solve the practicum problems of each group. One of them is done by tracing the source of the internet to the problem of using practicum tools and materials, procedural practicum activities, so that it can discuss directly with laboratory assistants who accompany each group.

Overall, every aspect of the indicator is in the "very high" category which means that the collaboration skills in each class run well during the real laboratory activities. Furthermore, the analysis is carried out by comparing the average value of the pretest and the value of the NGain score shown in Table 3.

Based on the data obtained in the control class and the experimental class shown in Table 3, the data is re-analyzed using the normality test and the homogeneity test. The data normality test in this study used the Kolmogorov Smirnov Test technique with data used against students in control classes and experimental classes. The N-Gain Score normality test result in the control class is 0.200 and an experimental class of 0.200 with a significant level of ά = 5%. Based on the results of the processing, it can be concluded that the distribution of data on N-Gain Score values in both classes is declared normal distributed. Furthermore, the testing of variant homogeneity using Levene's Test of Equality of Error Variances to look at the homogeneity of both classes namely Levene's statistical significance is greater than 0.05. This shows that the data is homogeneous.

TABLE 3: Difference in pretest average value with N-Gain.

| Score | Class | Average Score | Normality | Homogeneity | Significant |
|---|---|---|---|---|---|
| *Pretest* | Experiment | 73.33 | > $\alpha$ Sig (0.200) > (0.05) (Normal) | < $\alpha$ Sig (0.000) < (0.05) (Homogeneous) | > $\alpha$ Sig (1.783) > (0.05) (Significant Changes) |
| | Control | 61.53 | > $\alpha$ Sig (0.086) > (0.05) (Normal) | | |
| *N-Gain* | Experiment | 53.20 | > $\alpha$ Sig (0.200) > (0.05) (Normal) | < $\alpha$ Sig (0.329) > (0.05) (Homogeneous) | > $\alpha$ Sig (0.078) > (0.05) (Significant Changes) |
| | Control | 42.17 | > $\alpha$ Sig (0.200) > (0.05) (Normal) | | |

The percentage difference in control classes and experimental classes during real laboratory activities using discovery learning models looks quite significant. The average N-Gain score achieved in the control class was 42.17%, while the average score in the experimental class was 53.20% with a percentage difference of 11.03%. When viewed in the N-Gain Score range table both classes are in the “medium” category. The discovery learning model used is quite a positive influence during real laboratory activities by looking at the acquisition of pre-posttest and damp values for student responses. This is in accordance with research conducted by [7, 13, 15]. These studies showed the same positive influence on improving collaboration skills using discovery learning models during real laboratory activities.

## 4. CONCLUSION

Based on the results of research thathas been conducted, it can be concluded that the collaboration skills possessed by first-year students of the Class of 2021/2022 from two different classes who participated in the Basic Physics Practicum II course at the Department of Physics Education, UIN Sunan Gunung Djati Bandung using the discovery learning model were quite positive influenced with an average score of 53.20%. This “medium” category, explains that all students in collaborating with their group of friends are good enough because every indicator can be met. Learners also gave a positive response to the assessment of collaboration skills using student

response questionnaires because the results of questionnaire calculations showed the score range in the range of “medium” categories of 70%-85%.

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