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## Analysis of Students' Scientific Literacy Abilities with Application Problem Based Learning and Discovery Learning Models

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**Abstract:** The aim of this research is to determine the improvement and differences in students' scientific literacy abilities taught using the Problem Based Learning and the Discovery Learning model assisted by animated video media on chemical equilibrium material. The sampling technique was carried out using purposive sampling, resulting in class XI IPA 5, totaling 34 students, as experimental class I and XI IPA 6, totaling 36 students, as experimental class II. In learning, the test instrument uses cognitive levels C4 to C6. The results of students' scientific literacy abilities taught using the Problem Based Learning model have increased with an average value from 47.05 to 82.94, as well as the results of students' scientific literacy abilities taught using the Discovery Learning model, namely with an average value of 44.17 to 79.94. Through hypothesis testing using the Independent Sample T-Test with the prerequisites of normality and homogeneity, a Sig (2-Tailed) value of 0.024 was obtained, so it can be concluded that  $H_a$  is accepted. The results of this research show that there are differences in the scientific literacy abilities of students taught using the Problem Based Learning and the Discovery Learning model assisted by animated video media on chemical equilibrium material.

**Keywords:** Scientific Literacy Ability; Problem Based Learning; Discovery Learning; Animated Video Media; Chemical Equilibrium

## INTRODUCTION

In the 21<sup>st</sup> century, the development of modernization and globalization has had a tremendous impact. One of the transmitted effects is to guarantee students to identify, understand and solve problems around them independently. One of the impacts of modernization and globalization felt by Indonesian society is the low thinking ability of students. The results of the international

PISA research show that Indonesian students have very low literacy levels in reading, mathematics and science. They only occupy the bottom 10 of 65 countries (Panggabean et al., 2022).

Students at SMA Negeri 5 Medan tend to be less involved during the learning process. Based on interviews, only 34% of students were declared complete and the remaining 66% were declared failed in

learning chemical equilibrium with a KKM score of 75. The results of observations obtained by researchers were that students lacked scientific literacy, especially in terms

It is important to understand chemical equilibrium material thoroughly because it is the basis for understanding related material, such as hydrolysis, solubility, and acid-base equilibrium (Jusniar & Syamsidah, 2021). In order to learn chemical equilibrium easily, you need skills, one of which is scientific literacy skills. Scientific literacy ability is the ability to connect scientific concepts and knowledge with contemporary problems. Someone who has scientific literacy skills, capable using scientific concepts, have science process skills to assess in making decisions now relate to other people, society and environment (Ginting et al., 2022).

To improve scientific literacy skills so that students' understanding of material equilibrium becomes better, it is necessary to apply an interactive learning model. One of them is a Problem Based Learning model. Problem Based Learning (PBL) is one of the innovative learning models that can provide active learning conditions for students. The PBL model prepares lessons for critical and analytical thinking, as well as for finding and using learning resources (Meilasari et al., 2020). This is supported by research conducted by (Susi & Yenti, 2020), which stated that the results of students' scientific literacy skills were  $t_{\text{count}} > t_{\text{table}}$ , ( $8.66 > 1.69$ ) at a significance level of 5%. In addition to the PBL model, (Miasari et al., 2020) mentioned that one of the methods that may call for teachers to be more inventive in assisting pupils to be able to actively learn to find their own information is the Discovery Learning model. This is also supported by this improvement in academic performance indicated by the acquisition of  $t_{\text{count}} (3.63) > t_{\text{table}} (1.679)$ .

The implementation of the learning model will not be effective without the help of media. The application of animated video media is an effort to improve students' scientific literacy skills in abstract equilibrium

of science process skills. This is because educators still use conventional models and rely on textbook media, which leads to a learning process that is more teacher-centered. The implementation of the learning model will not be effective without the help of media. The application of animated video media is an effort to improve students' scientific literacy skills in abstract equilibrium material (Brata et al., 2020). This is proven by (Pratama et al., 2023) research that  $t_{\text{count}} (5.32) > t_{\text{table}} (2.013)$ . The application of Problem-Based Learning models and Discovery Learning assisted by animated video media really helps students improve their scientific literacy skills so that the results they obtain are very satisfying (Doyan et al., 2020).

## LITERATURE REVIEW

### Problem Based Learning

The Problem Based Learning (PBL) model encourages students to think critically and analytically to solve a problem. The PBL model emphasizes student-centered learning. This allows students to learn more things (Hotimah, 2020). The PBL structure has five steps: (1) orienting students to the problem; (2) organizing students to learn; (3) direct both individuals and groups investigate; (4) create and present work; and (5) examine and assess the approach taken solve the problem (Roza & Damanik, 2022).

The benefits of the PBL learning model are: (1) Students remember and understand the open material better; (2) Can improve and focus more on relevant abilities; (3) Encourage students to think critically; (4) Can develop work teamwork, leadership, and social skills; and (5) Can motivate students to be more proactive in learning (Rasyid et al., 2022). The PBL model has several disadvantages, are: (a) Not many teachers are able to teach students problem solving; (b) Requires high costs and a long time; (c) Difficult to integrate students' out-of-school activities; and (d) Learning success depends on student discipline (Hayun & Syawaly, 2019).

## **Discovery Learning**

Discovery Learning is learning to discover concepts, meaning, and causal relationships through organizing learning carried out by students. Principles of the Discovery Learning Model that is, students are asked to identify what you want to know then look for the information yourself form understanding as output (Yunsyahana et al., 2022). Based on the syntax, steps Discovery Learning is divided into 6, namely: (1) Stimulation; (2) Problem Statement; (3) Data Collection; (4) Data Procession; (5) Verification; and (6) Generalization (Yuliana, 2018).

The advantages of the Discovery Learning model are: (a) Helping students to improve and enhance cognitive skills and processes; (b) students can develop; (c) Able to cause feelings of joy and happiness; and (d) Helping students eliminate doubts. Meanwhile, the disadvantages are (1) Students who have cognitive limitations will experience difficulty in abstract thinking; and (2) requires a lot of time to study (Noormaliana, 2022).

In general, the science process skills that will be analyzed are basic and integrated skills, which include: (1) observation skills; (2) classify; (3) predict; (4) formulate the problem; (5) formulate a hypothesis; (6) determine variables; (7) investigate; (8) analyzing data; (9) conclude; and (10) communicate (Lepiyanto, 2017).

## **Animation Video Media**

Animated video media is media in the form of images in frames that are mechanically projected through a projector lens onto a screen so that the image appears alive on the screen. Animated video media can present information, show procedures, explain complex ideas, teach skills, shorten or lengthen time, and influence attitudes (Parera et al., 2022).

Some of the advantages of using animated video media in learning are as follows: (1) It can make it easier for teachers

to explain information about complex material; (2) Using a combination of audio and visual media; (3) Can attract students' attention and focus; (4) Has interactive properties; and (5) Independent. The disadvantages of animated video media are as follows: (1) Special software is required to create learning media with animation; (2) Creative design and skills are required to create effective animations for use as learning media; and (3) There are no real images such as photography and video (Dzakwan, 2020).

## **Scientific Literacy Ability**

Scientific literacy skills are scientific knowledge and abilities to identify problems, obtain the latest information, explain scientific symptoms, make conclusions based on facts, understand how science and technology shape nature, intelligence and culture, and have the desire to participate and care about scientific issues (OECD, 2017).

Scientific literacy consists of four dimensions: science competence/process, science knowledge/content, science application context, and science attitude. This research is limited to science competencies/processes. Science process emphasizes that students utilize learning processes, activities and creativity to acquire scientific knowledge, skills, values and attitudes and to apply them in everyday life. One of the benefits of science process skills is as follows: (1) helping students solve problems they face every day; (2) provide students with resources to form their own concepts and learning approaches; (3) helping students who are still in the concrete thinking development stage; and (4) increasing student creativity (Fitriana et al., 2019).

## **METHODS**

The research carried out was quantitative research using a quasi-experimental method with a Pretest and Post-Test Control Group Design. The sampling technique used purposive sampling technique so that 70 students were obtained from classes XI IPA 5 and XI IPA 6. Students, teachers, and chemical equilibrium material served as

research control variables. Scientific literacy ability functions as the dependent variable, while the independent variables include Problem Based Learning models, Discovery Learning models and animated video media.

The research instrument is a scientific literacy ability test in the form of an essay which has been prepared based on indicators in the scientific process skills aspect of 10 questions. This instrument meets the valid and reliable standards commonly used in research. The pretest and posttest data obtained in the form of quantitative data were analyzed using SPSS 25 for Windows software. Apart from that, the results of the pretest and posttest scores are described using the categorization taken in Table 1.

**Table 1.** Criteria for science process skills

| Intervals | Criteria   |
|-----------|------------|
| 81 - 100  | Very Good  |
| 61 - 80   | Good       |
| 41 - 60   | Enough     |
| 21 - 40   | Not Enough |
| 0 - 20    | Very Less  |

(Hadiyati et al., 2022)

## RESULT AND DISCUSSION

To measure students' science process skills (KPS), the essay test instrument consists of 10 questions that meet the criteria of 8 KPS indicators and represent each indicator of basic competency (KD) in chemical equilibrium material. The instrument used also meets test feasibility consisting of validity, reliability, level of difficulty and differentiability. So this instrument is suitable to be used to measure scientific literacy abilities in aspects of students' chemical science process skills. The results of the analysis of students' scientific literacy ability scores in experimental class 1 and experimental 2 can be seen in Table 2.

**Table 2.** Results of analysis of students' scientific literacy abilities

| Statistics        | Experiment I |          | Experiment II |          |
|-------------------|--------------|----------|---------------|----------|
|                   | Pretest      | Posttest | Pretest       | Posttest |
| The highest score | 68           | 97       | 67            | 94       |
| Lowest value      | 30           | 76       | 25            | 71       |
| Average           | 47.05        | 82.94    | 44.16         | 79.94    |

Table 2 illustrates that the ability to master science process skills of students in experimental class I who used the PBL model assisted by animated video media was higher compared to experimental class II who used the Discovery Learning model. This is in accordance with the theory which states that students' science process skills involve cognitive or intellectual, social and manual skills. Intellectual skills are involved because students' science process skills will involve the students' own way of thinking (Hariandi et al., 2023).

The PBL model is better in chemical equilibrium material compared to Discovery Learning because PBL emphasizes solving concrete problems that exist in the real world. Meanwhile, Discovery Learning focuses more on students and requires direct experience. In PBL syntax, the investigation stage can help students become more independent and responsible for problems. The teacher is responsible for ensuring the investigation process runs well. This has the potential to improve students' science process skills as well as their understanding of chemical equilibrium concepts. In addition, students taught with the PBL model are more active in seeking information during learning activities, while students taught with the Discovery Learning model participate less in expressing opinions during discussion sessions. The results of the pretest-posttest scores are then carried out prerequisite tests.

### Normality Test

To determine whether the data obtained is normally distributed or not, the Shapiro-Wilk test is carried out.

**Table 3.** Normality test experimental class I and experimental class II

| Class         | Data     | Sig. Data | Sig. Level ( $\alpha$ ) |
|---------------|----------|-----------|-------------------------|
| Experiment I  | Pretest  | 0.087     | 0.05                    |
|               | Posttest | 0.057     |                         |
| Experiment II | Pretest  | 0.087     |                         |
|               | Posstest | 0.170     |                         |

Table 3 contains data on the pretest and posttest results for experimental class I and experimental class II. Based on this table

it can be concluded that the two classes produced normally distributed data because the significance value was  $> 0.05$ .

### Homogeneity Test

By examining the extent of deviations that occur, the homogeneity test is used to estimate the degree of scattering of quantitative data or the degree of homogeneity of data within one data group. The homogeneity test used is the Levene test.

**Table 4.** Homogeneity test experimental class I and experimental class II

| Data     | Class                         | Sig. Data | Sig Level. (a) |
|----------|-------------------------------|-----------|----------------|
| Pretest  | Experiment-I<br>Experiment-II | 0.526     | 0.05           |
| Posttest | Experiment-I<br>Experiment-II | 0.847     |                |

From the results of Table 4, it can be concluded that the two experimental classes are homogeneous because the significance value is  $> 0.05$ .

### Hypothesis Test

To find out the differences between the two experimental classes, a statistical test was carried out using the SPSS for Windows software program, namely the Independent Sample T-Test.

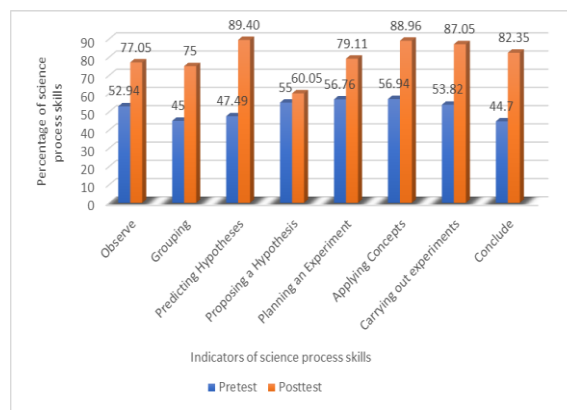
**Table 5.** Hypothesis test experimental class I and experimental class II

| Class         | Average | t <sub>count</sub> | t <sub>table</sub> | SPSS |
|---------------|---------|--------------------|--------------------|------|
| Experiment I  | 82.94   | 2.621              | 1.997              | .024 |
| Experiment II | 79.94   |                    |                    |      |

Based on the results of hypothesis test calculations, data on the results of scientific literacy abilities in the aspect of students' science competence/process obtained a value of Sig.(2-Tailed) = 0.024  $<$  0.05. Because the significance value obtained is smaller than 0.05, H<sub>a</sub> is accepted. It can be concluded that there are differences in the scientific literacy abilities of students who are taught using the Problem Based Learning model and the Discovery Learning model assisted by animated video media on chemical equilibrium material.

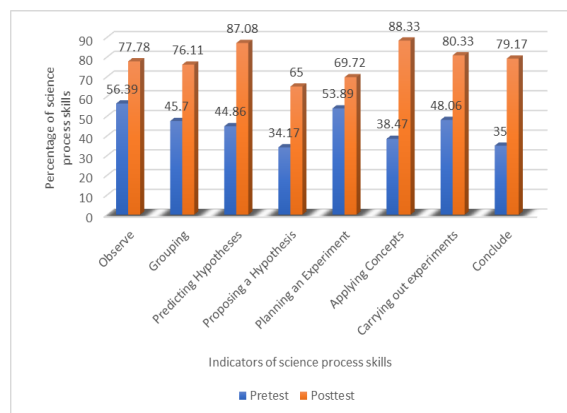
The pretest-posttest results of students' science process skills were analyzed based on

their respective indicators. Details can be seen in the following figure.



**Figure 1.** Pretest and posttest percentage results of achievement of science process skills for experimental class I students.

Figure 1 shows that there is an increase in the achievement of students' scientific process skill indicators in experimental class 1. Before being given treatment in the experimental class, the scores obtained were still low with the average score for experimental class 1 being 51.58. After being given treatment in the form of applying the PBL model, there was an increase in students' science process skills to 79.87. In experimental class 1, the highest achievement indicator was predicting a hypothesis (89.40) and the lowest was proposing a hypothesis (60.05). If the results are categorized as the average score of the class then it is included in the good category. The pretest-posttest results for experimental class 2 can be seen in Figure 2.



**Figure 2.** Pretest and posttest percentage results of achievement of science process skills for experimental class II students

Figure 2 is the result of increasing the achievement of indicators of students' science process skills in experimental class 2 which was taught using the DL model assisted by animated video media. Before being given treatment, the value obtained was 44.79. After being given treatment in the form of implementing a learning model, the students' science process skills increased to 78.00. In experimental class 2, the highest achievement indicator was applying concepts (88.33) and the lowest was advancing hypotheses (65.00). If the results are categorized as the average class score, then it is included in the good category. The results of this research are in line with previous research conducted by (Doyan et al., 2020) which shows that the experimental class with the PBL model obtained an N-Gain value of 68.06, while the experimental class with the Discovery Learning model obtained an N-gain value of 57.29. It can be concluded that the PBL model is better in improving students' science process skills.

## CONCLUSION

Based on the results of the research and discussion above, it can be concluded that: there is an increase in students' scientific literacy abilities who are taught using a problem-based learning model with a discovery learning model assisted by animated video media on chemical equilibrium material. With the average pretest-posttest score in experimental class 1 from 47.05 to 82.94. Meanwhile, in the experimental class II, the initial score was 44.16 to 79.94. Apart from the increase, there are differences in the results of scientific literacy abilities taught using the problem-based learning model and the discovery learning model assisted by animated video media on chemical equilibrium material. This is proven by the results of hypothesis test calculations using the Independent Sample T-Test, it is obtained that  $t_{\text{count}} (0.024) < t_{\text{table}} (0.05)$ , that  $H_a$  is accepted. Therefore, the use of media-assisted models greatly influences a person's ability to learn.

Technological developments have a positive impact on students' science knowledge

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