# Artikel

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# Analysis of Students' Scientific Literacy Ability in terms of Gender Using Science Teaching Materials Discovery Model Assisted by PHET Simulation

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**ABSTRACT**

**The purpose of this study was to analyze scientific literacy skills in terms of gender using discovery model science teaching materials assisted by Phet simulation. This research is a quantitative descriptive study with a one-group pretest and posttest design. This research was conducted at MTs Hidayatullah Mataram in class IXA students. The research was conducted in three meetings for 80 minutes each. The material used is static electricity which consists of five sub materials, namely static electricity, atoms, electric charge, Coulomb's law, and electroscope. The collection method of the scientific literacy test is in the form of multiple-choice with the indicators being to explain scientific phenomena, scientific discoveries, and statements, and use scientific data and evidence. Prior to use, a feasibility test was carried out. The results of the item analysis show that people have a good level of adjustment, reliability, and difficulty level. The results of the analysis of scientific literacy ability showed that female students and male students had different scientific literacy abilities. The scientific literacy ability of female students is higher (80%) than male students (77.95). However, there are two sub-materials of static electricity and one indicator of scientific literacy which are dominated by male students.**

**Keywords: science teaching materials, discovery learning models, scientific literacy, gender**

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## INTRODUCTION

21st Century Skills is a very important topic to be discussed in the world of education (Chalkiadaki, 2018) because it is closely related to the development of science and technology (Handajani & Pratiwi, 2018). 21st Century Learners are digital learners and independent thinkers. The main objective of these 21st Century skills is to prepare students to solve complex problems related to competitive and technology-intensive daily life (Anagun, 2018; Cevik & Senturk, 2019). Van et al., (2019) stated that 21st Century skills are in line with the demands of education that are more focused on creative and critical approaches to problem-solving and decision-making. 21st-century teaching is expected to produce human resources who can master various forms of 21st-century skills, one of which is mastering scientific literacy (Menggo et al., 2019; Rio et al., 2020).

Scientific literacy was first introduced in 1958 by De Paul Hard Hurd, McCurry, and Rockefeller Brothers Pund (Khaeroningtyas et al., 2016). In 1958, Paul De Hard Hurd introduced scientific literacy as a goal of science education (Naganuma, 2017; Valladares, 2021). Scientific literacy is the ability of students to use their scientific knowledge in identifying questions, making conclusions, and making decisions based on the results that have been collected about what they are facing (Efendi et al., 2021; MM et al., 2020; Widiyanti et al., 2015). Scientific literacy is related to students' creative thinking skills (Bahtiar & Ibrahim, 2022). Students who have scientific literacy skills are students who can understand the concepts, principles, and theories that form the basis of scientific thinking (OECD, 2018; Ke et al., 2021). The emphasis on scientific literacy in learning aims to develop students' competence in constructing scientific knowledge using the scientific method (Liu et al., 2022).

Based on the results of the Program for International Student Assessment (PISA) report, in 2018 Indonesia ranked 396. This shows that the results obtained by Indonesian students are far below the OECD average and experienced a significant decline, from 403 to 396 (Schleicher, 2018). The results of the PISA report are presented in the following image.

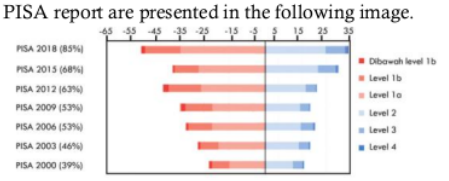


**Figure 1.** Indonesian Students' Scientific Literacy Results

The figure shows that for the field of science, competency level 1a refers to students' ability to use general materials and procedural knowledge to recognize or distinguish explanations of simple scientific phenomena. In OECD countries, 15.7% of students have a competency level of 1a, and only 5.5% of students score below it. In Indonesia, 35% of students are still in the competency group level 1a and 17% at lower levels. The low scientific literacy of students in Indonesia is caused by several factors including The low ability of students to read, and interpret data in the form of tables, diagrams, graphs, and other forms of presentation (Pujawan et al., 2022); students understand science as a theory so that it is still difficult to apply scientific concepts and scientific facts in everyday life (Lestari et al., 2019; Rahayu et al., 2022); The low level of students' understanding of the nature of science (NoS) (Wei & Lin, 2022). The low value of scientific literacy obtained by Indonesia at PISA 2018 was also due to problems in teaching science in Indonesia (Putri et al., 2021). Scientific literacy needs to get serious attention and be addressed as soon as possible to improve the quality of Indonesian education (Jeong et al., 2021).

One of the efforts that can help improve students' scientific literacy is to use appropriate teaching materials in science learning. Science learning is learning that provides opportunities for students to gain hands-on experience so that it can increase students' strength to accept, store, and apply the concepts they have learned. In essence, science is built on the basis of scientific products, scientific processes, and scientific attitudes (Yasar, 2017; Ozdem et al., 2020). Student involvement in science learning is shown in several science activities, such as the process of observing, discussing, analyzing data, and presenting the results of observations (Margunayasa, 2019; Hussein et al., 2019). These conditions must be followed by learning that can meet the demands of the times (Inkinen et al., 2020).

The discovery learning model is one of the learning models that can facilitate students in the concept discovery process (Gunawan et al., 2021; Lestari, 2020). The discovery learning model emphasizes the discovery of concepts and or principles that are not yet owned by students (Ritonga, 2021). Through the discovery learning model, students are familiar with the scientific method and have the ability to think critically and analytically (Serevina & Luthfi, 2021). The main goal of the discovery learning model is to increase students' understanding of knowledge construction through scaffolding, symbolic representation, and discovery (Ozdem et al., 2020). The application of discovery learning models in learning must be accompanied by learning media that support investigation through experimentation (Van Joolingen, 2005).

Learning media that facilitate students in the learning process is also very important to apply (Muhammad, 2021; Winarni et al., 2020). One of the learning media that can be used is Phet simulation. Phet simulation is a website-based simulation developed by simulation experts from the University of Colorado Boulder to help students learn through simulated learning (Najib et al., 2022; Ben Ouahi et al., 2022). This PhET simulation is made in Java or Flash so that it can be run directly from a website using a standard web browser (Eichler, 2022; Qu et al., 2022). The use of Phet Simulation in learning provides interesting things to students so that students can observe directly what is observed and simulated (Rahmawati et al., 2022; Watson et al., 2020; Herrington et al., 2022).

This study aims to analyze the scientific literacy skills of students in terms of gender after using discovery learning model teaching materials assisted

by PheT simulation. This research was conducted for three main reasons. First, students have difficulty interpreting data in the form of tables, diagrams, graphs, and other forms of presentation. Second, students find it difficult to relate the concepts they get to everyday life experiences. Third, students have difficulty accepting the concepts taught by using passive learning models and unattractive learning media. Thus, this research specifically answers: "Do male and female students have good scientific literacy skills about static electricity after using the discovery learning model assisted by PheT simulation?

## METHODS

### *Research Design*

This research is quantitative descriptive. Quasi-experimental research is an experimental research that can be applied to only one group which is the experimental class without any comparison group or control group (Arikunto, 2011). The research design used in this study was a one-group pre-test post-test design. This research design is presented in the form of the following table.

**Table 1.** Desain One Group Pretest-Postest

| Pretest | Treatment | Post-test |
|---|---|---|
| $O_1$ | X | $O_2$ |

### *Participants*

The population used in this study were all students of class VIII MTs Hidayatullah Mataram. This population will be used as a research sample. The research sample is part of the population. The sampling technique used was purposive sampling. This means that the sample is taken because of certain considerations. The consideration in question is that the class that is the research sample has not studied static electricity material, while the other classes have started to study the material. So that the research sample is 30 students in class IX-A.

### *Research Procedures*

This research was conducted from April to May 2022 at MTs Hidayatullah Mataram. The timing of this research is right in the even semester of the 2021/2022 academic year. This research was conducted in stages as presented in the following table.

**Table 2.** Research procedure

| No. | Stages | Activity |
|---|---|---|
| 1. | Research Preparation Stages | Research design<br>Study of literature<br>Observing the school environment<br>Developing science teaching materials for the Discovery Learning model<br>Preparing the Phet Simulation media<br>Making scientific literacy questions |
| 2. | Stages of Research Implementation | Validating the instrument for Scientific Literacy<br>Carry out pretest<br>Carry out learning using science teaching materials with discovery learning models assisted by Phet Simulation<br>Melaksanakan postest |
| 3. | Final Stages of Research | Perform data processing and analysis<br>Make a discussion of the research results<br>Making research conclusions |

### *Instruments*

The research instrument according to Sugiyono (2005) is a tool used to measure the observed natural and social phenomena. From this understanding, it can be understood that an instrument is a tool used by researchers in using data collection methods systematically and more easily. The instrument that the researcher used in this study was a multiple-choice scientific literacy test with 15 questions. The following is a grid of scientific literacy questions.

**Table 3.** Grid of Science Literacy Questions

| No. | Sub Material | Scientific Literacy Indicator | No. Item |
|---|---|---|---|
| 1. | Static electricity | Explaining phenomena scientifically | Q1 |
| | | Evaluating and designing scientific statements | Q2 |
| | | Interpret data and evidence scientifically | Q3 |
| 2. | Atom | Explaining phenomena scientifically | Q4 |
| | | Evaluating and designing scientific statements | Q5 |
| | | Interpret data and evidence scientifically | Q6 |
| 3. | Electrical charge | Explaining phenomena scientifically | Q7 |
| | | Evaluating and designing scientific statements | Q8 |
| | | Interpret data and evidence scientifically | Q9 |
| 4. | Coulomb's Law | Explaining phenomena scientifically | Q10 |
| | | Evaluating and designing scientific statements | Q11 |
| | | Interpret data and evidence scientifically | Q12 |
| 5. | electroscope | Explaining phenomena scientifically | Q13 |
| | | Evaluating and designing scientific statements | Q14 |
| | | Interpret data and evidence scientifically | Q15 |

*Data Analysis*

Data analysis is one of the final stages of the research process. Data analysis in this study consisted of instrument analysis, and analysis of scientific literacy skills. Analysis of the data in this study using the Rash model and the help of SPSS software. Rash modeling is used to analyze the instrument and analyze students' scientific literacy skills, with the following equation.

$$P_{ni}\left(x_{ni}=\frac{1}{\beta_n},\delta_i\right)=\frac{e^{(\beta_n-\delta_i)}}{1+e^{(\beta_n-\delta_i)}}$$

where $P_{ni}\left(x_{ni}=\frac{1}{\beta_n},\delta_i\right)$ is the probability of resondent n in item i to produce a correct answer (x=1); with the respondent's ability, $\beta_n$, and the difficulty level of the item $\delta_i$.

## RESULTS AND DISCUSSION

This study aims to analyze students' scientific literacy skills after using science teaching materials using the PheT simulation-assisted discovery learning model. This research was conducted on the subject matter of static electricity. The results of the research and discussion are described as follows.

*Analysis of Question Instruments*

Analysis of scientific literacy questions was carried out before the implementation and implementation of learning was carried out. The instrument analysis was carried out to determine the level of suitability of the questions, the level of reliability of the questions, and the level of difficulty of the questions. The results of the instrument analysis for the level of suitability of the items are presented in the following table.

**Table 4.** Output Item Fit

| ENTRY NUMBER | TOTAL SCORE | TOTAL COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD | PTMEASUR-AL CORR. | PTMEASUR-AL EXP. | EXACT MATCH OBS% | EXACT MATCH EXP% | Item |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 17 | 30 | .15 | .43 | 1.32 | 1.56 | 1.20 | .75 | A .33 | .51 | 53.3 | 73.4 | Q12 |
| 9 | 14 | 30 | .69 | .43 | 1.29 | 1.47 | 1.31 | 1.10 | B .33 | .51 | 60.0 | 72.7 | Q9 |
| 4 | 11 | 30 | 1.25 | .44 | 1.21 | 1.04 | 1.21 | .69 | C .37 | .50 | 66.7 | 73.8 | Q4 |
| 14 | 18 | 30 | -.04 | .43 | 1.12 | .66 | 1.04 | .23 | D .44 | .51 | 70.0 | 74.1 | Q14 |
| 7 | 21 | 30 | -.63 | .46 | 1.06 | .34 | 1.07 | .29 | E .43 | .48 | 80.0 | 76.5 | Q7 |
| 13 | 8 | 30 | 1.86 | .47 | 1.01 | .12 | .85 | -.18 | F .46 | .46 | 83.3 | 78.0 | Q13 |
| 5 | 18 | 30 | -.04 | .43 | .86 | -.65 | .99 | .07 | G .57 | .51 | 83.3 | 74.1 | Q5 |
| 8 | 25 | 30 | -1.58 | .54 | .98 | .03 | .56 | -.49 | H .45 | .39 | 76.7 | 83.7 | Q8 |
| 3 | 17 | 30 | .15 | .43 | .96 | -.16 | .90 | -.24 | g .55 | .51 | 73.3 | 73.4 | Q3 |
| 10 | 16 | 30 | .33 | .43 | .95 | -.18 | .92 | -.19 | f .55 | .52 | 70.0 | 73.1 | Q10 |
| 15 | 7 | 30 | 2.09 | .49 | .94 | -.17 | .65 | -.56 | e .51 | .44 | 80.0 | 79.5 | Q15 |
| 1 | 19 | 30 | -.23 | .44 | .92 | -.34 | .76 | -.67 | d .57 | .50 | 73.3 | 74.7 | Q1 |
| 6 | 24 | 30 | -1.31 | .51 | .83 | -.58 | .53 | -.72 | c .55 | .42 | 86.7 | 81.2 | Q6 |
| 11 | 20 | 30 | -.42 | .45 | .83 | -.79 | .80 | -.43 | b .59 | .49 | 83.3 | 75.5 | Q11 |
| 2 | 27 | 30 | -2.27 | .65 | .74 | -.55 | .33 | -.53 | a .50 | .31 | 90.0 | 89.9 | Q2 |
| MEAN | 17.5 | 30.0 | .00 | .47 | 1.00 | .1 | .87 | -.1 | | | 75.3 | 76.9 | |
| P.SD | 5.6 | .0 | 1.15 | .06 | .17 | .7 | .27 | .5 | | | 9.8 | 4.7 | |

According to Boone et al., (2014) and Bond & Fox (2015), the value of outfit means-square, outfit z-standard, and point measure correlation are the criteria used to see the level of suitability of items. If the items in the three criteria are not met, it is certain that the items are not good enough so they need to be improved. In the output table above, it can be seen that the questions Q2, Q12, Q9, and Q4 only do not meet one criterion, so there are no items that need to be changed or replaced. The results of the reliability analysis are presented in the following table form.

**Table 2a.** Output Reliabilitas

SUMMARY OF 30 MEASURED Person

| | TOTAL SCORE | COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD |
|---|---|---|---|---|---|---|---|---|
| MEAN | 8.7 | 15.0 | .51 | .67 | 1.01 | .11 | .87 | -.04 |
| SEM | .6 | .0 | .24 | .02 | .04 | .15 | .06 | .11 |
| P.SD | 3.3 | .0 | 1.30 | .11 | .24 | .82 | .30 | .58 |
| S.SD | 3.3 | .0 | 1.32 | .11 | .24 | .84 | .30 | .59 |
| MAX. | 14.0 | 15.0 | 3.16 | 1.07 | 1.53 | 1.98 | 1.55 | 1.34 |
| MIN. | 3.0 | 15.0 | -1.72 | .58 | .63 | -1.45 | .25 | -1.15 |

| | | | | | | |
|---|---|---|---|---|---|---|
| REAL RMSE | .71 | TRUE SD | 1.09 | SEPARATION | 1.53 | Person RELIABILITY .70 |
| MODEL RMSE | .68 | TRUE SD | 1.11 | SEPARATION | 1.64 | Person RELIABILITY .73 |

S.E. OF Person MEAN = .24

Person RAW SCORE-TO-MEASURE CORRELATION = .99
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .76 SEM = 1.61

**Table 2b.** Output

SUMMARY OF 15 MEASURED Item

| | TOTAL SCORE | COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD |
|---|---|---|---|---|---|---|---|---|
| MEAN | 17.5 | 30.0 | .00 | .47 | 1.00 | .12 | .87 | -.06 |
| SEM | 1.5 | .0 | .31 | .02 | .04 | .19 | .07 | .15 |
| P.SD | 5.6 | .0 | 1.15 | .06 | .17 | .73 | .27 | .55 |
| S.SD | 5.8 | .0 | 1.19 | .06 | .17 | .75 | .28 | .56 |
| MAX. | 27.0 | 30.0 | 2.09 | .65 | 1.32 | 1.56 | 1.31 | 1.10 |
| MIN. | 7.0 | 30.0 | -2.27 | .43 | .74 | -.79 | .33 | -.72 |

| | | | | | | |
|---|---|---|---|---|---|---|
| REAL RMSE | .48 | TRUE SD | 1.05 | SEPARATION | 2.16 | Item RELIABILITY .82 |
| MODEL RMSE | .47 | TRUE SD | 1.05 | SEPARATION | 2.24 | Item RELIABILITY .83 |

S.E. OF Item MEAN = .31

Item RAW SCORE-TO-MEASURE CORRELATION = -1.00
Global statistics: please see Table 44.
UMEAN=.0000 USCALE=1.0000

The table above shows that the value of Person reliability obtained is 0.70, while the value of Item Reliability is 0.82. This indicates that the consistency of students' answers in solving scientific literacy questions according to the level of difficulty is sufficient, but the quality of the items used as data collection instruments for students' scientific literacy on static electricity is of good quality. The table above also shows that the Cronbach Alpha value is 0.76. This value indicates that the interaction between students' scientific literacy skills and the overall scientific literacy items is good. The next instrument analysis related to the level of difficulty of the questions. The results of the analysis of the level of difficulty of the questions are presented in Table 3 below.

**Table 3.** Output Tingkat Kesukaran Soal

| ENTRY NUMBER | TOTAL SCORE | TOTAL COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD | PTMEASUR-AL CORR. | PTMEASUR-AL EXP. | EXACT MATCH OBS% | EXACT MATCH EXP% | Item |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 7 | 30 | 2.09 | .49 | .94 | -.17 | .65 | -.56 | .51 | .44 | 80.0 | 79.5 | Q15 |
| 13 | 8 | 30 | 1.86 | .47 | 1.01 | .12 | .85 | -.18 | .46 | .46 | 83.3 | 78.0 | Q13 |
| 4 | 11 | 30 | 1.25 | .44 | 1.21 | 1.04 | 1.21 | .69 | .37 | .50 | 66.7 | 73.8 | Q4 |
| 9 | 14 | 30 | .69 | .43 | 1.29 | 1.47 | 1.31 | 1.10 | .33 | .51 | 60.0 | 72.7 | Q9 |
| 10 | 16 | 30 | .33 | .43 | .95 | -.18 | .92 | -.19 | .55 | .52 | 70.0 | 73.1 | Q10 |
| 3 | 17 | 30 | .15 | .43 | .96 | -.16 | .90 | -.24 | .55 | .51 | 73.3 | 73.4 | Q3 |
| 12 | 17 | 30 | .15 | .43 | 1.32 | 1.56 | 1.20 | .75 | .33 | .51 | 53.3 | 73.4 | Q12 |
| 5 | 18 | 30 | -.04 | .43 | .86 | -.65 | .99 | .07 | .57 | .51 | 83.3 | 74.1 | Q5 |
| 14 | 18 | 30 | -.04 | .43 | 1.12 | .66 | 1.04 | .23 | .44 | .51 | 70.0 | 74.1 | Q14 |
| 1 | 19 | 30 | -.23 | .44 | .92 | -.34 | .76 | -.67 | .57 | .50 | 73.3 | 74.7 | Q1 |
| 11 | 20 | 30 | -.42 | .45 | .83 | -.79 | .80 | -.43 | .59 | .49 | 83.3 | 75.5 | Q11 |
| 7 | 21 | 30 | -.63 | .46 | 1.06 | .34 | 1.07 | .29 | .43 | .48 | 80.0 | 76.5 | Q7 |
| 6 | 24 | 30 | -1.31 | .51 | .83 | -.58 | .53 | -.72 | .55 | .42 | 86.7 | 81.2 | Q6 |
| 8 | 25 | 30 | -1.58 | .54 | .98 | .03 | .56 | -.49 | .45 | .39 | 76.7 | 83.7 | Q8 |
| 2 | 27 | 30 | -2.27 | .65 | .74 | -.55 | .33 | -.53 | .50 | .31 | 90.0 | 89.9 | Q2 |
| MEAN | 17.5 | 30.0 | .00 | .47 | 1.00 | .1 | .87 | -.1 | | | 75.3 | 76.9 | |
| P.SD | 5.6 | .0 | 1.15 | .06 | .17 | .7 | .27 | .5 | | | 9.8 | 4.7 | |

Characteristics of scientific literacy questions were analyzed based on item response theory with the Rasch model assisted by the Winstep program. Based on the Rasch (1PL) model, the characteristic of the items that can be seen is the level of difficulty of the items. The criteria for the level of difficulty of the items are divided into five categories, namely the categories of very easy, easy, medium, difficult, and very difficult items. Based on the table above, it is known that the level of difficulty of the questions varies. This can be seen from the various Measure values in the table. The questions from the easiest to the most difficult are Q2, Q8, Q6, Q7, Q11, Q1, Q14, Q5, Q12, Q3, Q10, Q9, Q4, Q13, and Q15. The level of difficulty of the items in the very easy criteria is 5 items (33.33%). Analysis of scientific literacy questions can also be seen from the following test information function graph.

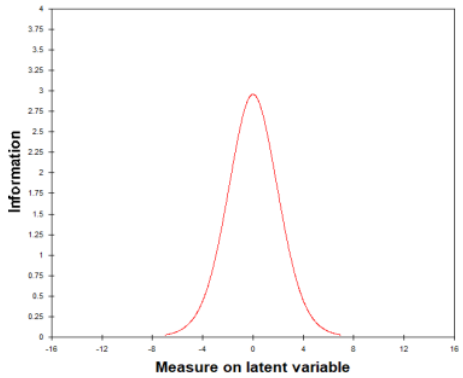


**Figure 2.** Test Information Function

The picture above shows the measurement information obtained from the scientific literacy question instrument on static electricity material. The x-axis shows the level of students' ability in doing the given test, while the y-axis shows the value of the information function. Based on the figure, at the medium ability level, the information obtained by the measurement is very high. So that the development of the instrument for scientific literacy questions for students with static electricity is suitable if it is used for students with moderate abilities.

***Analysis of Students' Scientific Literacy Ability***

After testing the instrument and getting the results suitable for use in research, the next stage is the research implementation stage. At the implementation stage of this research, the researcher first conducted a pretest to the students who were selected as research samples. The pretest was carried out to determine the students' initial abilities related to scientific literacy. The results of the students' pretest analysis are presented in the following form.

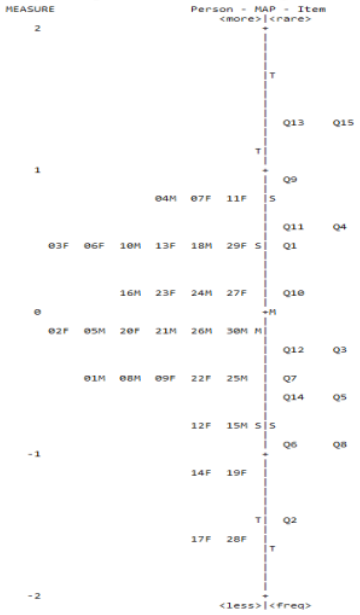


**Figure 2.** Person-Item Map Pretest

Based on the data obtained through Wright's map in Figure 2 above, we can observe the distribution of students' abilities in answering each scientific literacy question. The distribution of students' abilities was analyzed based on the logit measure value. The average logit value is always set at 0.0 logit which is the standard for the level of difficulty of the questions and the standard for student abilities. Students 04M, 07F, and 011F are students who have the highest level of literacy ability with a logit measure value of +0.79. However, they were unable to answer questions Q9, Q13, and Q15 which had the highest logit value. Students who are below 0.00 logit are included in the category of students who have abilities below the average standard level of problem difficulty. Based on the Wright map image above, it can be seen that as many as 17 students have below-average scientific literacy skills. In addition, there are also two students, namely 17F and 28F who are in the outliers category (below the T scale of questions) or students who have low abilities from the lowest difficulty of the questions (Q2). The low ability of scientific literacy in students is due to the fact that students have not received complete static electricity material. Lestari et al., (2021) stated that the low pretest results of students' scientific literacy skills were due to the previously not student-centered learning process.

Students' scientific literacy ability can also be seen from the scalogram which is the distribution of answers given by students at the time of the pretest.

```
Person |Item
       |     1   11   1 11
       |268547320141935
       |---------------
  4 +111111110101000   04M
  7 +111111010011001   07F
 11 +111111111001000   11F
  3 +111101110110000   03F
  6 +111101101000101   06F
 10 +111001000111110   10M
 13 +111101110110000   13F
 18 +111101110110000   18M
 29 +110111110110000   29F
 16 +110111100010001   16M
 23 +111110000001110   23F
 24 +111101101010000   24M
 27 +001010011001111   27F
  2 +111001011000100   02F
  5 +000111110000011   05M
 20 +110110100101000   20F
 21 +111110101000000   21M
 26 +111110101000000   26M
 30 +111110001000001   30M
  1 +101110011000000   01M
  8 +100001101010100   08M
  9 +000010011101010   09F
 22 +100011101100000   22F
 25 +000010011101010   25M
 12 +110000010010100   12F
 15 +001001000101100   15M
 14 +110010010000000   14F
 19 +111000010000000   19F
 17 +001001100000000   17F
 28 +001110000000000   28F
       |---------------
       |     1   11   1 11
       |268547320141935
```

**Figure 3.** Guttman Scalogram of Responses

The distribution of the students' pretest answers above shows that the 9F and 25M students in addition to not being careful (cannot do the easiest questions, item Q2; can work on difficult questions (Q13). This indicates a lucky guess. In addition, the picture above also shows that students are 03F, 13F, and 18M; 14F and 19F; and 21M and 26M have the same answer distribution pattern. This indicates the occurrence of mutual cheating. In addition to numbers, information on students' scientific literacy abilities is also presented in the following figure.


**Figure 4**. Person DIF Plot Pretest

Based on the picture above, it can be seen that male and female students do not have significant differences in scientific literacy abilities. Where the logit measure value obtained by male and female students is almost the same. The picture shows a curve that is close to the upper limit as in the questions Q13 and Q15, indicating that the questions can be solved by both male and female students.

Based on the description above, it is known that students still have limited scientific literacy abilities. students' initial ability to scientific literacy is still low, both female and male students still find it difficult to answer difficult questions. This can be seen from the majority of students' abilities spread below 0.0 logit. In addition, the pattern of answers given by students is almost the same. This indicates that at the time of the test, students cooperated more in solving the given scientific literacy questions. This is done by students because they are not used to solving scientific literacy questions even though they are in the form of multiple choice.

After the pretest was conducted, students were taught to use discovery model teaching materials assisted by PheT simulation. This learning is carried out for three meetings, where each meeting lasts for 80 minutes of the teaching and learning process. During the learning process, it was seen that students were enthusiastic in learning. Students seemed interested in the PheT media used. In addition, students are also serious in completing the experiments given in the form of student worksheets. After the teaching and learning process using discovery model teaching materials assisted by PheT simulation was carried out, the researchers then carried out a final test to measure the students' final abilities. The results of the analysis of students' final tests are shown in the following figure.

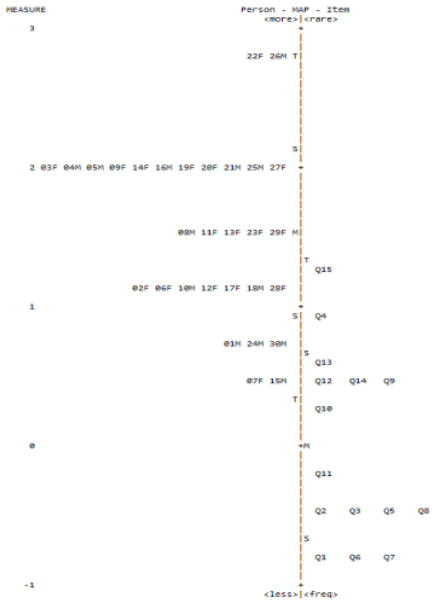


**Figure 5.** Person-Item Map Postest

Based on the picture above, it is known that, in this condition students have the ability to master the given scientific literacy questions. This can be seen from all student abilities spread over 0.0 logit. Students who have the best scientific literacy skills are students 22F and 26M, while students who have fairly good scientific literacy skills are students 07F and 15M. scientific literacy skills can also be seen in the following figure.


**Figure 6.** Person DIF Plot Postest

Based on the graph in Figure 6, we can evaluate student achievement on each item of the question. The items that are the easiest to answer for both female and male students are items Q1, Q6, and Q7 about static electricity, atoms, and electric charge. These questions were easier for female students to answer than boys. Both groups of students both have scientific literacy abilities above 0.0 logit or higher than the average level of problem difficulty. The question that has the largest logit is item Q15 about electroscopes. However, most of the female and male students could answer this question. Differences in the scientific literacy ability of male and female students also occur in other questions. The ability of female students is higher than that of male students on items Q1, Q3, Q4, Q5, Q6, Q8, and Q11.

Analysis was also carried out to determine the level of students' scientific literacy skills based on the static electricity sub-material. The following is a bar chart that shows the average value of scientific literacy skills obtained by female and male students.

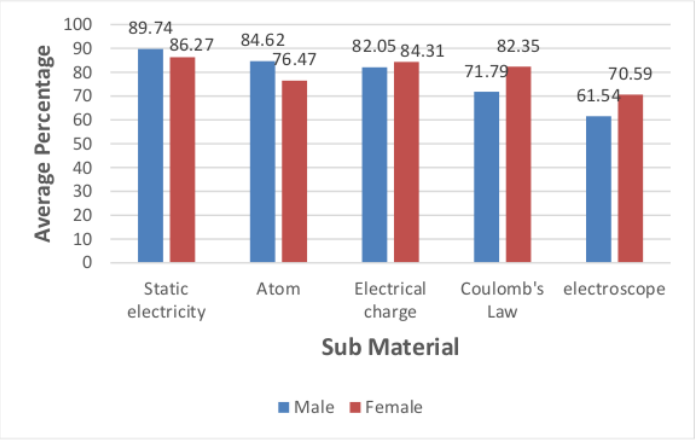


**Figure 7.** Comparison of Students' Literacy Ability Based on Sub Material

Figure 7 shows that the ability of male and female students for each sub-material of static electricity is different. However, the difference is not too big. In the static electricity sub-material and atomic sub-material, male students are higher than female students. This is because in the learning process using discovery model teaching materials assisted by PheT simulation, male students are more active and enthusiastic than female students. In addition, male students were also more likely to try new things in PheT simulations than female students who were more focused on what was instructed on student worksheets only. Balloons and Static Electricity is one of the simulations that contain a lot of static electricity content related to positive and negative charges (Ajredini, 2017). The Balloons and Static Electricity simulation allows students to flexibly explore static electricity (Lewis, 2018). Concepts such as transfer of charge, induction, attraction, repulsion, and grounding. The illustration of the PheT simulation used in static electricity and atomic sub-materials is as follows.

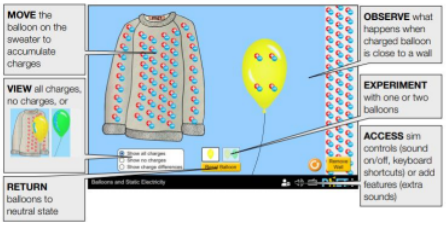


**Figure 8A.** Phet Simulation of Static and Atomic Electricity Sub-Material

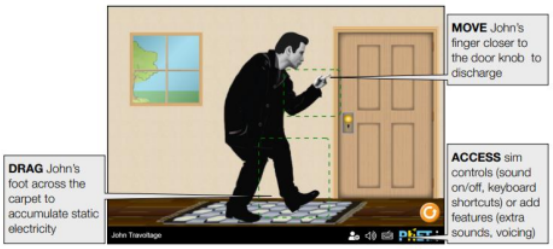


**Figure 8B.** Phet Simulation of Static and Atomic Electricity Sub-Material

In the sub-material of electric charge, Coulomb's Law, and electroscope, it was found that the average percentage of female students was higher than that of male students. This is because female students are able to operate with the maximum Phet simulation given. In Charges and Fields, students explore electrostatics as they arrange positive and negative charge space and observe the resulting electric field, voltage, and equipotential lines.

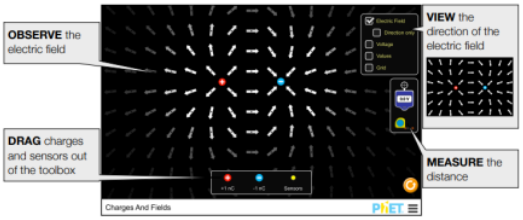


**Figure 9.** Phet Simulation of Sub-Material Electric Charge and Coulomb's Law

In addition to analyzing scientific literacy skills based on sub-materials, an analysis of students' scientific literacy skills was also carried out based on the indicators. Here is a picture related to this.

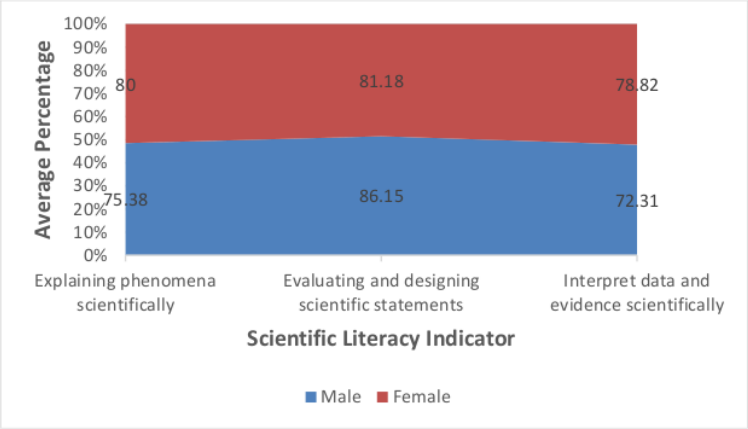


**Figure 10.** Comparison of Students' Science Literacy Ability Based on Indicators

Based on Figure 11, it is known that the scientific literacy ability of female students on the indicators of explaining phenomena scientifically and interpreting data and evidence scientifically is higher than that of male students. This shows that female students understand better in applying scientific knowledge in situations given in the form of questions. Female students are also better at describing or interpreting phenomena scientifically. In addition, female students are also better at identifying the assumptions, evidence, and reasons behind the conclusions drawn.

However, on the indicators of evaluating and designing scientific statements, the ability of male students is higher than that of female students. This indicates that male students understand better about describing and evaluating the methods used in solving problems, and are able to propose a method of investigation. The results of this study are in line with research conducted by Susongko et al., (2021) which suggested that in science learning, female students need to be given further training in the ability to evaluate and design scientific statements, while male students need further training in explaining phenomena scientifically and interpret data and evidence scientifically. In general, students' scientific literacy skills after using discovery model teaching materials assisted by Phet simulation are presented in the following figure.

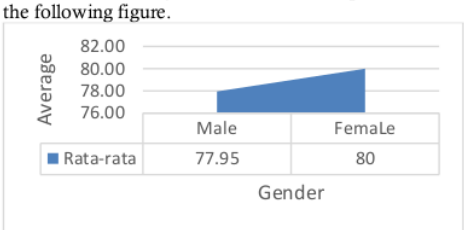


**Figure 11.** Comparison of Students' Literacy Ability Based on Gender

In general, Figure 7 shows that the scientific literacy ability of female students is higher than the scientific literacy ability of male students. Where female students get an average percentage of scientific literacy of 80.00% while boys are 77.95%. Based on the findings that have been stated, the authors recommend adding student-centered collaborative learning activities. Students can be grouped heterogeneously with the aim that male students can be helped by female students who tend to more easily master certain parts of the concept. On the other hand, some parts of the concept are easier for boys to understand. This is in line with research conducted by Mukti et al., (2019); Hamuda et al., (2019) who concluded that the scientific literacy ability of female students was higher than that of male students.

The high scientific literacy ability of both female and male students is due to the use of discovery model teaching materials. Discovery teaching materials are one of the teaching materials that can create a student-centered learning atmosphere (Rosen et al., 2021; Gunawan et al., 2021; Rizki et al., 2021). The development of discovery model science teaching materials aims for students to be able to find out for themselves what is being researched based on the worksheets that have been provided (Muntie et al., 2019; Elizar et al., 2018). Apart from the discovery model, Satri & Herumurti (2021) stated that the media also plays an important role in the learning process. Learning media that can be used such as Phet simulation can replace experimental activities directly. With the Phet simulation, it is easier for students to understand the concepts being studied (Price et al., 2018; Salame & Makki, 2021). This PhET simulation media was developed to help students understand science concepts visually using dynamic graphics (Mahtari et al., 2020).

## CONCLUSION

Based on the description above, it can be concluded that the scientific literacy skills of students before and after using discovery model science teaching materials assisted by Phet simulation in the process of learning static electricity material in class IX students of MTs Hidayatullah Mataram are different. The average posttest score is higher than the pretest. The average scientific literacy ability of female students at the time of the posttest was higher than that of male students. However, in some sub-materials of static electricity, the literacy ability of male students is higher than that of female students. In terms of scientific literacy indicators, the two scientific literacy indicators for female students are higher than for male students.

The impact of this research in the world of education is to provide new knowledge, insight, and information about learning models and learning media, especially Phet simulations that can be used in science learning. With the results of this study, it can also be a reference and

information for teachers in paying attention to diversity in the division of male and female groups. Some of the limitations associated with this research are that this research only analyzes the data on instrument questions and students' scientific literacy skills. Further analysis related to the increase and the effect of discovery model science teaching materials assisted by Phet simulation is very possible. In addition, researchers also still use a small sample, so it is possible to increase the number of samples in further research.

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