Profile of students' scientific literacy on particle dynamics

S Mahtari¹, M Wati¹, S Rizky¹, D Dewantara¹ and B K Prahani²
¹Department of Physics Education, Universitas Lambung Mangkurat, Banjarmasin,
²Department of Physics, Universitas Negeri Surabaya, Surabaya

saiyidah_pfis@ulm.ac.id

Abstract. This study measures students' ability to complete scientific literacy instruments on particle dynamics material analyzed using the Rasch model. This study uses a quantitative descriptive research design with a survey method. The research subjects were 29 students of class XI IPA 2 at State Senior High School 6 Banjarmasin. The data collection technique was carried out using a scientific literacy test on particle dynamics material in the form of reasoned multiple choice questions as many as ten questions. The research data were analyzed using the Rasch model with the Winstep program. The results showed that the MNSQ outfit was 0.94, Outfit ZSTD was 0.05, person reliability was 0.58 in the weak category, Cronbach's alpha reliability was 0.92, the separation value was 1.17 with two groups. The students' scientific literacy ability is quite good but still needs to be improved and retrained.

1. Introduction

PISA (Program for International Student Assessment) is an international student assessment program conducted every three years by the Organization for Economic Co-operation and Development (OECD) or economic cooperation and development based in Paris, France. The PISA survey was conducted to measure students' abilities in reading, math, and science. The essential knowledge that is the main focus tested in the PISA survey is literacy or reading. In science, scientific literacy is defined as the ability to explain a scientific phenomenon, evaluate and design scientific questions, and interpret data and evidence to devote attention to scientific topics or ideas as a form of reflection [1].

Indonesia has been following the PISA study since 2000. One of the main reasons is understanding student achievement in Indonesia compared to international standards and other countries facing the same challenges [2]. The Indonesian state PISA study results in science that Indonesia's scientific literacy is still very low [3]. Indonesia's scientific literacy score is still far from the international average score and consistently ranks in the top 10 from the bottom, decreasing. In addition, the results of the PISA study also show that most of the students in Indonesia are at level 1, where students have limited knowledge of science that can only be applied to situations or problems that they are familiar with [4].

Scientific literacy is critical to be mastered by students because it relates to the way students understand their environment, health, economy, and other problems faced by modern society, which is very dependent on progress and technology, and the development of science [5]. Therefore, it is essential to survey the field to determine the students' scientific literacy ability. Thus, this study aims to measure students' ability to complete scientific literacy instruments on particle dynamics material analyzed using the Rasch model.
2. Method

The method used in this research is the descriptive method using the survey technique. The subjects of this study were students of class XI IPA 2 at State Senior High School 6 Banjarmasin, totaling 29 people who had studied particle dynamics material in the previous semester. The instrument used to measure scientific literacy skills is in the form of multiple-choice questions based on scientific literacy as many as ten questions that are done online via google records with one day processing time. The students' test results were then used as data in this study and then analyzed using the Rasch model in the Winstep program to determine the logit value.

The output in this software is in the form of table measuring items (item fit order), size of people (person fit order), variable maps (variable maps), reliability, and summary statistics (summary statistics). According to Suminto and Widhiarso, dividing items into four categories [6]. The criteria are used to check the suitability of the items [7]. Outfit means-square (MNSQ) value received: 0.5 < MNSQ < 1.5. Outfit Z-standard (ZSTD) value accepted: -2.0 < ZSTD < +2. Point Measure Correlation (Pt Mean Corr) value : 0.4 < Pt Mean Corr < 0.85. An item is considered biased if the probability value is < 5% (<0.05).

3. Result and Discussion

Based on Table 1, It is found that the logit or measure value of the person measure is 0.11 and the item measure is 0.00, which means that the student's ability is higher than the level of difficulty of the questions. So that it allows all the questions to be answered correctly by students, and students who have high abilities can answer complex questions correctly. In addition, it is obtained from Table 1. that person reliability is 0.58. The reliability is included in the weak category (<0.67), while item reliability is 0.85, which is included in the excellent category (0.8-0.9). The value of Cronbach's Alpha (measuring the reliability of interaction between person and item as a whole) is 0.71, which is included in the good category. The separation value of the person is two, and the thing is 4, which means that for the person, there are two groups, capable and unable or high ability and low ability. The item groups are divided into four groups: difficult, medium, easy, and very easy.

| Table 1. Statistic summary |
|---------------------------|
| Description | Score |
| Logit | Person | 0.11 |
| | Item | 0.00 |
| Reliability | Person Reliability | 0.58 |
| | Item Reliability | 0.85 |
| | Alpha Cronbach | 0.71 |
| Separation | Person | 1.17 |
| | Item | 2.42 |
| Outfit MNSQ | Person | 0.94 |
| | Item | 0.94 |
| Outfit ZSTD | Person | 0.05 |
| | Item | 0.05 |

Another quantity shown in table 1 is the value of the MNSQ outfit, both person and item, of 0.98, which is included in the fit criteria if it lies between 0.5 < MNSQ < 1.5, meaning that the test questions used are appropriate to measure students' scientific literacy skills. In addition, the ZSTD outfit value obtained was 0.05, which is between the interval -2 < ZSTD < 2, meaning the data has a possible rational value or in other words, the question as a whole is by the Rasch model and can be used as a test question on particle dynamics material to measure the ability student scientific literacy.

The variable maps are one of the outputs of the winstep program. The variable map shows student ability and item difficulty distribution on the same logit scale [8]. Students' abilities are listed on the left side of the map, while item difficulty levels are on the right side of the map. Logits 0 is set as the
average of test items [9]. Based on Figure 1, a map of variables shows that item number 10 is the most challenging question and number 2 is a straightforward question. In addition, 19 students can solve scientific literacy problems with logit > 0.00, while ten students get logit scores < 0.00. The students with codes 05P, 24L, and 27P have the highest ability or ability, while those with codes 08L, 12P, 25L, and 17P have the lowest abilities. Therefore, the students' scientific literacy skills are pretty good but still need improvement and retraining. Items 3, 6, and 9 are on the same line. It shows that the questions have the same level of difficulty according to the program, so that from these three items, only one item can be selected as well as items 4 and 5 which are on the same line.

More frequent students can improve students' scientific literacy with scientific literacy questions [10]. It can also be done by using textbooks and learning patterns oriented to scientific literacy [11]. In addition, students' scientific literacy skills can be improved by using innovative learning models, modules, student worksheets, media, and evaluation questions that can improve students' scientific literacy skills [12].
4. Conclusion
Based on the results and discussion, it can be concluded that the scientific literacy instrument made can measure students' scientific literacy skills, and the results obtained are pretty good for students' abilities but still need to be improved based on the logit value of 0.11. Thus, it is necessary to have an essential role in learning and providing examples in everyday life to enhance students' scientific literacy skills.

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