# The Chemical Literacy Understanding of Chemistry Teachers at Islamic Senior High School

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**Abstract.** Chemical literacy has a role in helping students understand local and global issues such as the energy crisis, environment, and health. Teachers need an adequate understanding of chemical literacy to plan appropriate learning and design adequate assessment instruments. This study aims to analyze the description of chemical literacy skills in chemistry teachers at Madrasah Aliyah (Islamic Senior High School). This research is a quantitative descriptive method that describes the understanding of chemical literacy. A total of 85 teachers from 12 Madrasah Aliyah in Central Java, Indonesia were respondents. The research data were obtained by questionnaire with a total of 24 statements about the components of chemical literacy. Questionnaire analysis carried out to see the relationship between teacher understanding in assessing chemical literacy, obtained by using RASCH analysis. The results showed that the reliability of the questionnaire was 0.98. Cronbach's Alpha (α) which measures the interaction between respondents and items has a value of 0.96. This value indicates the instrument used is in perfect condition and effective with a high level of reliability so that it can use in actual research. The results showed that the teachers had not fully understood the domains and aspects of chemical literacy skills. The Wright map shows only 30% of respondents (teachers) understand the aspects of chemical literacy and apply them in chemistry learning. The results of this study suggest that policymakers such as the government and educational institutions, hold more in-house training and workshops on chemical literacy for teachers.

**Keywords:** Questionnaire, Chemical literacy, Chemistry teachers, Level understanding, Rasch Model

## 1. Introduction

Education is the main driving force for nation-building. Growth of educational institutions is essential. It is not only to produce someone by knowledgeable in a particular field but also to produce someone who has excellent soft skills such as thinking skills, communication skills, teamwork, problem-solving skills and other essential skills to meet the challenges of the 21st century [1]. In schools, the education system used is more oriented towards textbooks; it seems that it needs to adjust for students who have the skills to search, understand and analyze information critically [2]. Education must be meaningful, schools are agents of change by providing contextual learning to produce educational outcomes according to the demands of the times [3].

One of the abilities currently needed for 21st-century education is literacy skills it includes many things, digital literacy skills, financial literacy, social and cultural literacy, and scientific literacy. This literacy ability is the starting point for mastering many aspects of skills in the 21st century [4, 5]. Literacy skills are not only skilled enough to read, write or communicate but the ability to connect knowledge with problems of everyday life [6].

Like the COVID-19 phenomenon, which has become an epidemic since the beginning of 2020, literacy skills are needed by people and students to build scientific opinions to form self-awareness to reduce the risk of spreading disease. This global awareness is closely related to literacy skills in many aspects. People who have this knowledge and can apply their knowledge to solve problems in real life are called literate societies science [7].

Based on the 2018 PISA report, almost developing countries have not shown high scores for literacy skills, Indonesia is one of them. Figure 1 shows, Indonesia's achievements have not shown a high jump in scores from 2006 to 2018, even for reading ability decreased in 2018. In almost all aspects of the 2018 PISA assessment, Indonesia is still below the OECD average. The low PISA assessment results are a big job for the government and educators in Indonesia. [1].

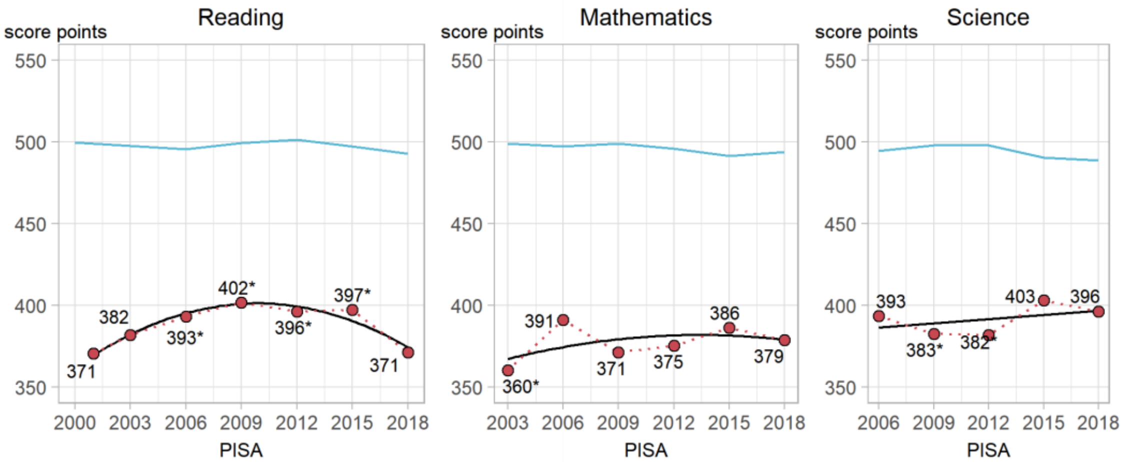


**Figure 1**. Trends in performance in reading, mathematics and science in Indonesia

As shown in Figure 1, the level of scientific literacy of Indonesian students as measured by PISA to date has shown low results. Low literacy skills are closely related to curriculum structure, learning objectives, learning design and teacher skills in understanding scientific literacy and implementing learning in the classroom. Teacher skills in classroom learning are related to pedagogical skills and mastery of teaching material content. Reforming the curriculum according to 21st-century education standards such as scientific literacy skills and critical thinking is not a tough job [7,8]. The most important thing is how to improve teacher understanding and skills in teaching. According to Glynn and Muth (1994), it is not enough to increase students' scientific literacy by adding a lot of scientific facts in learning and increasing the number of laboratory activities. However, students need to be provided with activities that emphasize minds-on, in addition to hands-on activities. Because the affective aspect is an essential factor in scientific literacy, it is necessary to include hearts-on in learning . In order for educators' efforts to optimally facilitate students in achieving these goals through learning chemistry, they need first to understand what scientific or chemical literacy means and how to optimize learning chemistry so that students have good chemical literacy [9,10].

To understand and be able to engage in a discussion of science and technology issues; There are three scientific literacy activities needed, namely evaluating, designing research, and analyzing or interpreting data. These three activities are very influential in explaining scientific phenomena in everyday life, almost all of which involve the discipline of chemistry [11]. All these competencies require three aspects of knowledge consisting of content knowledge, procedural knowledge, and epistemic knowledge. Content knowledge relates to science material conceptually or theoretically. Procedural knowledge is a standard procedure that underlies various methods and practices. Epistemic knowledge relates to ideas and ideas of science [12], the essence of science [13], and scientific practice [14]. So, scientific literacy is not only skilled at reading or evaluating relevant sources of science, but a series of learning activities to get meaning. The development of the definition of scientific literacy from year to year has changed. We are interested in the definition of scientific literacy, according to Holbrook & Rannikmae (2009). They suggest the need for an appreciation of the nature of science and its relevance to everyday phenomena. Science education that learned is not enough to gather information but is a comprehensive effort to develop scientific knowledge and skills creatively based on relevant scientific evidence. Scientific literacy also requires the ability to develop teamwork skills, communicative approaches, scientific discussion skills about phenomena, local and global issues, and being able to answer socio-scientific problems with adequate reasoning [15]. Finally, the ability of scientific literacy seen through the values of attitudes, morals, awareness, and ethics in everyday life [16].

The teacher holds an essential role in modern civilized society. Considered a social engineer, the teacher has extensive knowledge of various issues that affect our daily lives as a community of humanity. Therefore, teachers must have excellent and modern teaching skills and knowledge and be aware of the results of 21st-century education [2]. At present, the education curriculum in Indonesia is undergoing changes that adapted to the outcomes of the 21st-century education, such as critical thinking skills, higher-order thinking skills, and scientific literacy abilities. Information on the results of the 21st-century education for teachers in Indonesia still lacks, primarily Islamic senior high School (Madrasah Aliyah) teachers. Madrasah aliyah is a school managed by the Indonesian Ministry of Religion. Islamic senior high schools (Madrasah Aliyah) in Indonesia are quite large in number, and there are 1,294,776 Islamic senior high schools spread throughout Indonesia (BPS Indonesia, 2016). Puspendik Indonesia (2019) released data on the achievement of the 2018 National Examination.

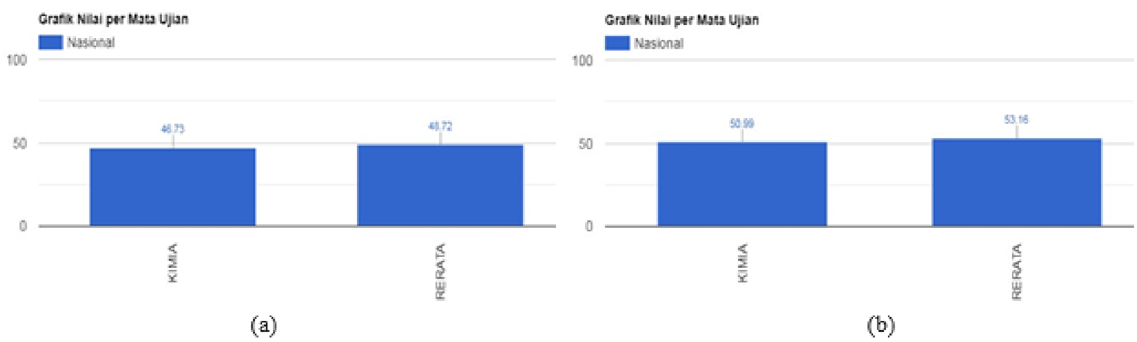


**Figure 2**. Comparison of the chemical values of Islamic senior high schools (a) and high schools (b) in 2019.

Figure 2 the results showed that the average achievement of the national chemistry exam in Islamic senior High Schools (Ministry of Religion) was lower than the general high schools (Ministry of National Education). The average national examination of Islamic Senior High Schools (Madrasah Aliyah) 46.73 and Senior High Schools (SMA) 50.99. As many as 20% of the 2019 national exams, chemistry questions are about high-order thinking skills (HOTs) and chemical literacy. Therefore, special attention is needed to improve the quality of education in Islamic senior high schools.

The purpose of this study was to conduct a preliminary study to determine the understanding and knowledge of teachers about chemical literacy skills. The results of this study are expected to determine the ability of teachers and map the level of knowledge of Islamic high school teachers about chemical literacy. Teachers who have good understanding and knowledge of chemical literacy will influence them to design appropriate learning, develop teaching materials, and compile assessment instruments. The results of this study are also useful for the government to evaluate and plan induction programs so that teachers get information from the novelty of 21st-century education. We are interested in conducting this research because of the lack of data on teacher competence in madrasah aliyah. Besides that, we also want to know the actions of teachers in carrying out distance learning during the pandemic, especially in connecting essential chemistry topics with global awareness related to the Covid-19 pandemic. The relationship between essential chemistry and Coronavirus is one of the literacy domains (context).

## 2. Research Methods

This survey research was conducted in Central Java, Indonesia, from March to April 2020. Sampling (participants) through a purposive sampling model [17]. As many as 24 statement items were compiled to measure the level of understanding of Islamic high school teachers about chemical literacy. The respondents consisted of 85 chemistry teachers, 25 male and 60 female. The questionnaire was distributed online to respondents using a google form. RASCH modelling becomes the basis of analysis to determine the measurement results of the instrument (chemical literacy understanding questionnaire). RASCH modelling using Winstep 3.73 program, this program can mathematically convert raw ordinal data into logit size and can assess the suitability of the overall instrument [18].

The results of the analysis with Winstep 3.73 can describe the level of difficulty of the questionnaire items and the level of the person's ability, and the relationship between the two can be explained clearly. The results of this analysis process produce a relevant output table that presents the diagnostic evaluation of the relevant instrument for reporting on the suitability statistics and psychometric properties of this instrument. Rasch modelling analysis used to determine the validity and reliability of the questionnaire developed [21,22]. Rasch model analysis uses to test the validity of the construct using analysis of grain polarity, dimensionality, and grain suitability. Analysis using RASCH modelling also produces an apparent wright map that can illustrate the relationship between item difficulty and respondent ability. Questionnaire-based on the definition of scientific literacy and chemical literacy, according to PISA (2015) and Swartz (2006) [19,20], Table 1 is a questionnaire component to determine the teacher's response to chemistry learning that has been implemented in schools.

**Table 1**. Questionnaire for understanding chemical literacy

| **Aspects** | **Descriptions** | **Item number** |
|---|---|---|
| literacy knowledge and understanding | Knowledge and understanding of scientific literacy or chemical literacy based on 21st-century educational outcomes, according to PISA 2015. | Q1, Q2, Q3, Q7, Q8 |
| Context | Context aspect of science literacy includes local and global science issues that require scientific understanding, such as efforts to inhibit the spread of the coronavirus by involving chemicals.. | Q4, Q5, Q6, Q9, Q10 |
| Knowledge | An understanding of facts, and concepts that build the foundation of scientific knowledge, such as the mechanism of soap or disinfectant that is capable of killing the coronavirus. | Q11, Q12, Q13, Q14, Q16 |
| Competency | The ability to explain phenomena scientifically, study and design experiments such as making hand sanitizers, disinfectants, and soaps. | Q15, Q17, Q18, Q19, Q20 |
| Attitude | Assessment of attitudes towards science that is indicated by an interest in science and technology, assessing the scientific approach to a proper inquiry, perception and awareness of environmental issues. | Q21, Q22, Q23, Q24 |

Twenty-four items of the questionnaire state in the form of a Likert scale, strongly disagree (STS), disagree (TS), neutral (N), Agree (S), and strongly agree (ST). Furthermore, the data were analyzed using the Rasch analysis through the WINSTEPS Version 3.73 program. This statistical program facilitates data from respondents and instrument items to describe the Wright and Mean Square Errors map. The Wright map is a visual representation of survey data that connects the ability of respondents who score high with how difficult the questionnaire items are using two vertical histograms on an integrated scale.

## 3. Results and Discussion

The questionnaire designed in this study was to determine the teacher's understanding of scientific literacy (chemistry) and its components. The questionnaire items were arranged based on aspects of chemical literacy, according to PISA 2015 and Swartz (2006). The two aspects of scientific literacy are not contradictory, and there is a clear correspondence [7]. these aspects are knowledge, context, competence, and attitude. Each aspect contains 4-5 statement items related to literacy skills. The questionnaire was distributed to 85 teachers (respondents) in Central Java, Indonesia. Filling in the questionnaire is done online with a confirmation technique via email so that the questionnaire data can be accounted for. The collected data were analyzed using RASCH modelling (Winsteps, 3.73).

Testing with the Rasch model approach using the winsteps program, when compared to testing the classical test theory model is an aspect of the respondent that can be correlated with the questionnaire items [23,24]. The results of the winsteps program analysis output displayed are as shown in Table 2 below;

**Table 2**. Informations of Output Winstep

| Output Winstep | Information |
|---|---|
| Summary statistic | Summary statistic aims to determine the overall quality of responses and items, as well as the interactions that occur both of them. |
| Item measure | Item measure aims to determine the quality of the item by measuring the logit of the item being tested. |
| Person measure | Person measure aims to determine the quality of respondents by measuring the logit of the respondents being tested. |
| Variable maps | Variable maps aims to explain the map of respondents and the items being tested. |
| Scalogram | Scalogram aims to see the results of the analysis in the form of a picture in scale form. |

The research data based on summary statistics, as shown in Table 3 illustrates the original appearance of the WinStep program. This research report uses the original appearance of the RASCH modelling with Winstep so that it can be understood, especially for researchers using the Winstep program. Summary statistics provide information about the quality of the overall pattern of the respondents, the quality of the instruments used, and the interactions between respondents and items. **Table 3** shows, the score of person reliability is 0.96, and the item reliability score is 0.97. Person reliability score above 0.91 is classified as an excellent score. The excellent score illustrates that as many as 85 respondents have very strong answer consistency. Likewise, the item reliability score shows a very high score, namely 0.97. The high item reliability score describes the quality of the questionnaire items in this study as very good.

Other data that can be used are INFIT MNSQ and OUTFIT MNSQ, for the person table, the average scores are 1.00 and 1.07. The ideal value of INFIT MNSQ and OUTFIT MNSQ is 1.00, the closer to 1.00, the better, overall, the research data shows a good score. Likewise for INFIT ZSTD and OUTFIT ZSTD which show a good score because the score is close to 0. The grouping of person and items can be shown from the separation score. The greater the separation, the better the overall quality of the instrument. Separation score identifies groups of respondents and items. The research data shows separation scores of 4.66 and 7.45; if these two scores are converted into a meaningful value, then they can be inputted in the following mathematical equation [24]

$$H = \frac{[(4xSeparation) + 1]}{3}$$

$$Hp = \frac{[(4\ x\ 4{,}66) + 1]}{3} = 6{,}55$$

$$Hi = \frac{[(4x\ 7{,}45) + 1]}{3} = 10{,}26$$

Separation person (*Hp*) score shows the number 6.55, which illustrates that six groups of respondents have the same answer pattern. Likewise, for the separation item score (*Hi*) which shows the number 10.06, there are ten groups of items that tend to be selected by respondents. This separation score describes a very diverse pattern of teacher answers.

These various response patterns indicate that teachers in general do not fully understand and know chemical literacy and aspects of literacy.

**Table 3**. Summary of Measured Person and Item

SUMMARY OF 85 MEASURED Person

| | TOTAL SCORE | COUNT | MEASURE | MODEL ERROR | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD |
|---|---|---|---|---|---|---|---|---|
| MEAN | 85.3 | 24.0 | 1.79 | .39 | 1.00 | -.3 | 1.07 | -.3 |
| S.D. | 13.3 | .2 | 2.16 | .05 | .66 | 1.9 | .82 | 2.0 |
| MAX. | 116.0 | 24.0 | 7.86 | .65 | 3.61 | 5.2 | 4.86 | 5.4 |
| MIN. | 67.0 | 23.0 | -.86 | .35 | .24 | -3.7 | .24 | -3.6 |

REAL RMSE .45 TRUE SD 2.12 SEPARATION 4.66 Person RELIABILITY .96
MODEL RMSE .40 TRUE SD 2.13 SEPARATION 5.34 Person RELIABILITY .97
S.E. OF Person MEAN = .24

Person RAW SCORE-TO-MEASURE CORRELATION = .99
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .96

SUMMARY OF 24 MEASURED Item

| | TOTAL SCORE | COUNT | MEASURE | MODEL ERROR | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD |
|---|---|---|---|---|---|---|---|---|
| MEAN | 302.0 | 84.9 | .00 | .21 | .93 | -.7 | 1.07 | -.1 |
| S.D. | 41.6 | .3 | 1.66 | .02 | .37 | 2.4 | .57 | 2.5 |
| MAX. | 363.0 | 85.0 | 3.14 | .25 | 1.95 | 5.0 | 2.86 | 5.5 |
| MIN. | 221.0 | 84.0 | -2.78 | .19 | .47 | -4.4 | .50 | -3.8 |

REAL RMSE .22 TRUE SD 1.65 SEPARATION 7.45 Item RELIABILITY .98
MODEL RMSE .21 TRUE SD 1.65 SEPARATION 7.94 Item RELIABILITY .98
S.E. OF Item MEAN = .35

UMEAN=.0000 USCALE=1.0000
Item RAW SCORE-TO-MEASURE CORRELATION = -1.00
2037 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 3062.63 with 1926 d.f. p=.0000
Global Root-Mean-Square Residual (excluding extreme scores): .5098

**Table 4**. Item fit statistics provided in a Winsteps output table

| ENTRY NUMBER | TOTAL SCORE | TOTAL COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | INFIT ZSTD | OUTFIT MNSQ | OUTFIT ZSTD | PT-MEASURE CORR. | PT-MEASURE EXP. | EXACT MATCH OBS% | EXACT MATCH EXP% | Item |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 221 | 85 | 3.14 | .20 | .97 | -.1 | .91 | -.5 | .85 | .79 | 64.7 | 66.5 | Q8 |
| 7 | 223 | 85 | 3.06 | .20 | .84 | -1.0 | .83 | -1.0 | .89 | .79 | 67.1 | 66.3 | Q7 |
| 6 | 236 | 85 | 2.55 | .20 | .63 | -2.7 | .64 | -2.5 | .91 | .78 | 72.9 | 64.2 | Q6 |
| 5 | 239 | 85 | 2.44 | .20 | .66 | -2.4 | .63 | -2.5 | .89 | .78 | 74.1 | 63.7 | Q5 |
| 4 | 255 | 85 | 1.84 | .19 | .70 | -2.2 | .77 | -1.6 | .91 | .76 | 69.4 | 61.2 | Q4 |
| 3 | 263 | 85 | 1.55 | .19 | 1.11 | .8 | 1.12 | .8 | .83 | .76 | 60.0 | 60.5 | Q3 |
| 24 | 282 | 85 | .86 | .19 | 1.46 | 2.8 | 1.60 | 3.3 | .60 | .73 | 51.8 | 62.4 | Q24 |
| 1 | 288 | 85 | .64 | .19 | 1.95 | 5.0 | 2.13 | 5.5 | .41 | .73 | 44.7 | 63.2 | Q1 |
| 19 | 294 | 85 | .42 | .19 | .54 | -3.6 | .69 | -2.2 | .83 | .72 | 80.0 | 63.8 | Q19 |
| 18 | 296 | 85 | .34 | .19 | .55 | -3.6 | .70 | -2.1 | .79 | .72 | 80.0 | 63.8 | Q18 |
| 23 | 303 | 85 | .08 | .20 | .84 | -1.1 | .89 | -.6 | .76 | .71 | 74.1 | 64.0 | Q23 |
| 9 | 308 | 85 | -.11 | .20 | 1.20 | 1.3 | 1.45 | 2.5 | .72 | .70 | 62.4 | 63.9 | Q9 |
| 10 | 313 | 85 | -.31 | .20 | .47 | -4.4 | .50 | -3.8 | .86 | .70 | 81.2 | 64.0 | Q10 |
| 14 | 322 | 84 | -.83 | .21 | 1.44 | 2.6 | 1.79 | 3.8 | .53 | .69 | 70.2 | 63.9 | Q14 |
| 12 | 333 | 85 | -1.15 | .21 | .62 | -2.8 | .59 | -2.6 | .73 | .68 | 72.9 | 66.1 | Q12 |
| 13 | 334 | 85 | -1.20 | .21 | 1.07 | .5 | 1.11 | .6 | .70 | .68 | 67.1 | 66.3 | Q13 |
| 20 | 334 | 85 | -1.20 | .21 | .89 | -.7 | 1.07 | .4 | .74 | .68 | 71.8 | 66.3 | Q20 |
| 11 | 336 | 85 | -1.29 | .22 | .63 | -2.7 | .59 | -2.5 | .76 | .68 | 82.4 | 67.2 | Q11 |
| 15 | 338 | 85 | -1.38 | .22 | 1.16 | 1.1 | 1.39 | 1.9 | .53 | .68 | 68.2 | 67.9 | Q15 |
| 21 | 339 | 85 | -1.43 | .22 | .71 | -2.0 | .89 | -.5 | .65 | .68 | 85.9 | 68.2 | Q21 |
| 22 | 337 | 84 | -1.52 | .22 | 1.22 | 1.3 | 1.50 | 2.2 | .52 | .68 | 61.9 | 69.1 | Q22 |
| 17 | 346 | 85 | -1.78 | .23 | .68 | -2.1 | .62 | -1.9 | .67 | .68 | 77.6 | 71.6 | Q17 |
| 16 | 344 | 84 | -1.91 | .23 | .55 | -3.0 | .50 | -2.6 | .73 | .68 | 86.9 | 72.9 | Q16 |
| 2 | 363 | 85 | -2.78 | .25 | 1.49 | 2.2 | 2.86 | 4.1 | .34 | .67 | 71.8 | 78.6 | Q2 |
| MEAN | 302.0 | 84.9 | .00 | .21 | .93 | -.7 | 1.07 | -.1 | | | 70.8 | 66.1 | |
| S.D. | 41.6 | .3 | 1.66 | .02 | .37 | 2.4 | .57 | 2.5 | | | 9.9 | 3.9 | |

Table 4 shows the item Measure of the research data. Item measure is a table that provides logit information for each question item. A high logit value indicates the level of difficulty or answers to disagree on the questionnaire. Item number 8 (Q8) shows a high logit number of 3.14, so the responses from many respondents stated that they strongly disagreed with item number 8. Item number 2 (Q2) shows the tendency of respondents to agree that it can be seen from the lowest, which is -2.78. The red column in the table shows the statement items that need to be revised (Q24, Q1, Q14, and Q2), because they have less good MNSQ and ZSTD outfit criteria. The criteria for a good MNSQ outfit are in the range 0.5 - 1.5, and a ZSTD outfit is in the range of -2.0 +2.0 [18]. Overall, this statistical item data illustrates that the instrument can work well, although there are four items that need to be improved.

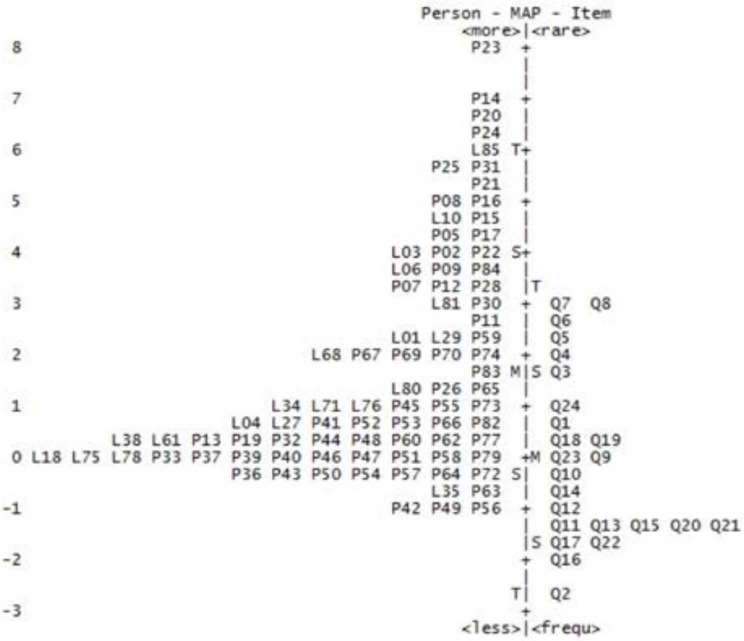


**Figure 3**. The Wright Map (Person–Item Map)

Figure 3. shows, items Q7 and Q8 only a few respondents stated their agreement. Q7's statement is "Teacher know the components of Chemical literacy ability", and Q8; "I use the attributes or components of chemical literacy in the purpose of learning chemistry". The Wright Map indicates that the majority of teachers (70%) have not known and understood the concept of scientific literacy, according to PISA 2015. On the other hand, items Q11, Q13, Q15, which are aspects of scientific literacy, all teachers (100%) answered their agreement which showed that they had assessed aspects of scientific literacy in chemistry learning. In this study, Q11 contained the statement, "The teacher conveys the importance of chemistry in explaining phenomena or situations in everyday life". Q13 contained that "the Teacher conveys the relevance of chemical products as consumers in decision making", the statement was an aspect of the knowledge of scientific literacy; An understanding of the central facts, concepts and explanatory theories that build the foundation of scientific knowledge. Overall, based on the questionnaire, most of the teachers did the learning according to the aspects of scientific literacy (chemical literacy), only a small portion carried out the scientific literacy aspects (chemical literacy) by referring to the scientific literacy framework based on PISA 2015.

Although they have claimed to carry out the assessment based on the chemical literacy component, it is necessary to investigate the chemical literacy assessment documents further, because the assessment of chemical literacy is not as simple as conventional assessments [10,25]. This research is a preliminary study to ask chemistry teachers to respond to an online questionnaire so that it only describes the teacher's condition of understanding chemical literacy based on the information they get.

The Wright Map is an exciting display in RASCH analysis; we can make conclusions based on the distribution of respondents' abilities and the level of difficulty of the item questions. Overall, Figure 3 shows that many respondents gave their approval to the statement items. As many as 30% of chemistry teachers in Central Java, Indonesia, have understood and applied assessments to measure chemical literacy skills in Islamic high school students. However, there are still a few people who do not understand the aspects and components of chemical literacy. The results of this study show conclusion that are almost the same as the data reported by PISA 2018, where Indonesia is still behind the OECD participating countries in literacy skills [1].

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)

| | -- Empirical -- | | | Modeled |
|---|---|---|---|---|
| Total raw variance in observations = | 77.5 | 100.0% | | 100.0% |
| Raw variance explained by measures = | 53.5 | 69.1% | | 66.8% |
| Raw variance explained by persons = | 28.6 | 36.9% | | 35.7% |
| Raw Variance explained by items = | 24.9 | 32.1% | | 31.1% |
| Raw unexplained variance (total) = | 24.0 | 30.9% | 100.0% | 33.2% |
| Unexplned variance in 1st contrast = | 4.3 | 5.5% | 17.9% | |
| Unexplned variance in 2nd contrast = | 3.1 | 4.0% | 13.0% | |
| Unexplned variance in 3rd contrast = | 2.0 | 2.5% | 8.2% | |

**Figure 4**. Standardizet Residual Variance

The unidimensionality of the instrument is an important measure for evaluating the developed instruments. The basic assumption of the Rasch measurement model is unidimensional: the test must measure one trait at a time [26,27]. The unidimensionality of the RASCH modelling with the Winstep program can be seen in the output "Standardized residual variance". Unidimensionality data can show the overall quality of the instrument, whether the instrument can measure what should be measured. Figure 4 shows the measurement result of raw variance data is 69.1%; this result exceeds the minimum requirement of 20% so that this data is extraordinary. The instrument to measure the level of understanding of chemical literacy in chemistry teachers was finally said to be good so that the measurement results could be accounted for and met the measurement standards. This unidimensionality data to strengthen the designed instrument, cannot describe qualitative descriptions or research results. Figure 4 is a screenshot from the Winstep 3.73 program, which shows that the Unidimensionality instrument requirements to measure the level of understanding of chemistry teachers about chemical literacy have met. Engelhard Jr (2013) suggested that further analysis of the dimensions could be achieved through the unit Eigenvalues of the observed data (4.3, 3.1, and 2.0) [27]. Figure 4 shows further evidence of the Unidimensionality defined in the unexplained variance (expressed in raw residuals) and the five factors indicate that the unit Eigenvalues are less than 15%.

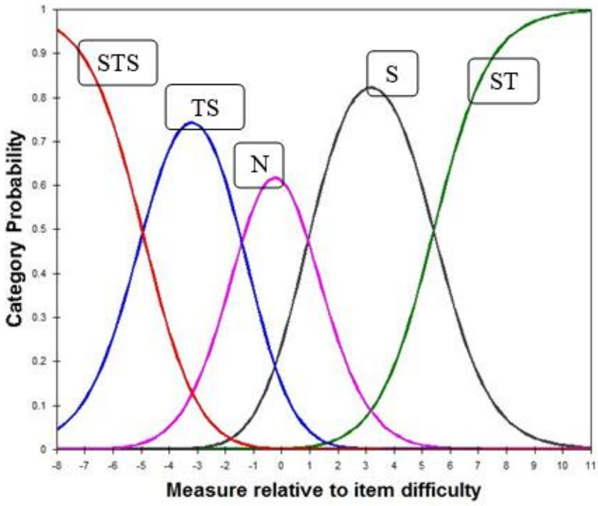


**Figure 5**. Category Probability Curve

Figure 5 shows the structure of the questionnaire rubric based on the RASCH analysis. Each questionnaire item in this study has a score that represents a different probability curve (i.e. the peak on the graph), which suggests that these five rating categories make sense. Each score in the questionnaire rubric has its probability curve. Respondents were asked to choose one of the following Likert-type options: STS = Strongly Disagree; TS = Disagree; N = Neutral; S = Agree; ST = Strongly Agree. This ranking choice reflects an increased level of latent constructs corresponding to the "strongly disagree", "disagree", "neutral", "agree" and "strongly agree" categories. The graph in Figure 5 illustrates the boundaries between the ordered response categories. Thus, each rating category is separated due to the item threshold value between these rating categories. The item threshold values are sorted from low to high and are presented in such a way that the first (1) probability curve intersects the second (2) probability curve followed by the third (3) and finally the fourth (4). It is a well-ordered item threshold value [28]. The probability curve category displayed in this report is to confirm that the instrument is good enough to measure the level of teacher understanding of scientific literacy (chemistry). The results of the curve do not suggest that the statement item should be discarded, but it needs to be revised according to Item fit statistics in table 4.

## 4. Conclusion

The research data revealed that the statistical summary results with RASCH modelling, the research instrument showed promising results, and could measure the actual research subject. As many as 30% of the 85 chemistry teachers indicated that they understood and recognized the components of science literacy based on PISA. Teachers claim to have implemented learning to empower scientific literacy (chemistry) skills. However, the results of this study are also unique, 70% of teachers are not familiar with chemical literacy skills but have carried out contextual learning by connecting chemistry with problems of everyday life, such as disinfectants and detergents to inhibit the spread of the coronavirus. Although learning by connecting the latest facts in everyday life is one of the components of scientific literacy (context), it is not sufficient to describe the proper scientific literacy skills. This research is a preliminary study to map the understanding of chemistry teachers about scientific literacy (chemistry). The results of this study prove that the pedagogical ability of teachers is still low; pedagogy is related to teaching skills based on the latest findings in education. Therefore the results of this study suggest that the government and educational institutions in Indonesia need much training, and dissemination of scientific literacy to teachers, teach them to use appropriate learning models in order to empower scientific literacy skills (chemistry) as a whole. Chemical literacy skills are not only shown by understanding and knowing contextual problems, but deep thinking activities and hands-on activities to solve daily (procedural) problems are very necessary.

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