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Validity and Reliability of the Global Warming Instrument: A Pilot Study Using Rasch Model Analysis

Mohd Zaidi Bin Amiruddin[1*], Achmad Samsudin[2], Andi Suhandi[1], Ida Kaniawati[1], Bayram Coştu[3], Adam Hadiana Aminuddin[4], & Fatah Kuniawan[5]

[1]Science Education Programme, Universitas Pendidikan Indonesia,Indonesia

[2]Physics Education Programme, Universitas Pendidikan Indonesia,Indonesia

[3]Department of Chemical Education, Yildiz Technical University, Turkey

[4]Physics Education Programme, Universitas Kebangsaan Republik Indonesia, Indonesia

[5]Thursina International Islamic Boarding School Malang, Indonesia

Abstract: This research aims to determine the profile of students regarding literacy skills for global warming material. This research uses a quantitative descriptive method to reveal the results of the research obtained based on students' responses to the 10 questions developed. This research was conducted at a school in Surabaya with a total of 15 respondents consisting of 4 men and 11 women. The results obtained were then analyzed using the Rasch Model with Winstep software to make it easier to map the level of instrument validity and the level of students' literacy skills. The results of this research reveal that the relationship between the instrument developed and students has very poor validity and reliability values with a value obtained of 0.22. However, the results of further analysis can map item difficulty levels and students' ability levels based on the Wright Map where students who have very high literacy skills are coded 01LK and 08PK while the most difficult item is Q2. Apart from that, students who have very poor literacy skills are good at coding 07LK while the easiest item is with code Q1. In this way, there is a need to improve problem instruments and further research to continue to develop the potential of scientific literature, not only on global warming material.

Keywords: instruments, literacy scientific, measurements, rasch model.

Abstrak: *Penelitian ini bertujuan untuk mengetahui profil siswa mengenai kemampuan literasi untuk materi pemanasan global. Penelitian ini menggunakan metode deskriptif kuantitatif untuk mengungkap hasil penelitian yang diperoleh berdasarkan respon siswa terhadap 10 pertanyaan yang dikembangkan. Penelitian ini dilakukan di salah satu sekolah di Surabaya dengan jumlah responden sebanyak 15 orang yang terdiri dari 4 laki-laki dan 11 perempuan. Hasil yang diperoleh kemudian dianalisis menggunakan Rasch Model dengan software Winstep untuk memudahkan dalam memetakan tingkat validitas instrumen dan tingkat kemampuan literasi siswa. Hasil dari penelitian ini mengungkapkan bahwa hubungan antara instrumen yang dikembangkan dengan siswa memiliki nilai validitas dan reliabilitas yang sangat buruk dengan nilai yang diperoleh sebesar 0,22. Namun, hasil analisis lebih lanjut dapat memetakan tingkat kesulitan butir soal dan tingkat kemampuan siswa berdasarkan Wright Map dimana siswa yang memiliki kemampuan literasi sangat tinggi diberi kode 01LK dan 08PK sedangkan butir soal yang paling sulit adalah Q2. Selain itu, siswa yang memiliki kemampuan literasi yang sangat kurang baik diberi kode 07LK sedangkan butir soal yang paling mudah diberi kode Q1. Dengan demikian, perlu adanya perbaikan instrumen soal dan penelitian lebih lanjut untuk terus mengembangkan potensi literatur ilmiah, tidak hanya pada materi pemanasan global.*

Kata kunci: *instrumen, literasi sains, pengukuran, model rasch.*

Mohd Zaidi Bin Amiruddin
*Email: mohdzaidi@upi.edu

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▪ INTRODUCTION

The majority of Indonesians believe that education should exclusively concentrate on developing students' cognitive or knowledge domains, ignoring their psychomotor or skill domains. Every person needs to possess certain talents or abilities, and one of those is scientific literacy (Arrafi et al., 2023; Jufrida et al., 2019). According to Sharon & Baram-Tsabari (2020), for a person to thrive in the age of scientific and technical advancement, they must have scientific literacy skills. The ability to comprehend and apply knowledge to solve problems relating to science and technology in daily life is known as scientific literacy. Scientific literacy skills not only help individuals to learn, develop, and interact but can also help each individual to fulfill skills in the 21st century (Afandi et al., 2019; Widodo et al., 2020). Scientific literacy consists of scientific concepts and processes that can help students make decisions using the knowledge they have. With scientific literacy skills, students can solve various problems related to science and technology in everyday life.

Currently, the younger generation is faced with various challenges such as globalization, advances in information technology, the convergence of science and technology, the influence and impact of technoscience, as well as mastery of TIMSS and PISA (Zhao, 2020). The majority of these difficulties are related to scientific literacy. People who lack scientific literacy will find it challenging to find solutions to ordinary social, educational, and scientific concerns. Thus, students must acquire and grow their scientific literacy abilities to prepare them for the range of difficulties that lie ahead. Learning how to use TIMSS and PISA is one of the difficulties associated with scientific literacy.

The program for International Student Assessment is an initiative that studies students' literacy in science, math, and reading among its member nations. PISA data from 2018 showed that Indonesian students scored 396 in scientific literacy, compared to research from 2015 that showed Indonesian students scored 403 in scientific literacy. This indicates that Indonesian students' scientific literacy score has declined and is still below the national average is 487 the OECD average. The PISA study's findings indicate that Indonesian pupils still have a comparatively low degree of scientific literacy. The research results Pittman et al. (2020) further support this, showing that students' scientific literacy abilities were still positioned low in all areas of scientific literacy. The poor scores attained when working on scientific literacy questions demonstrate that pupils are still incapable of having strong scientific literacy, according to research data (Čipková et al., 2020). The findings of the research are extremely alarming, given how crucial it is for students to acquire scientific literacy to thrive in the face of intense global competition (Kienhues et al., 2020; Valladares, 2021).

Students who possess scientific literacy abilities should be able to apply their scientific knowledge to solve a variety of science-related challenges. Right now, the global warming issue is shocking people all over the world. Scientists who alert the public about the effects of global warming serve as examples of this. Growing concentrations of greenhouse gasses brought on by human activity through the greenhouse effect are most likely to blame for the majority of the rise in the average world temperature since the mid-20th century (Dalaiden et al., 2022; Driga & Drigas, 2019; Drigas & Mitsea, 2021). Global warming can increase temperature and cause a food crisis. Global warming can hamper human life in the future if it is not immediately anticipated (Kamal, 2022; Kumar,

2023; Upadhyay, 2020). Therefore, in-depth knowledge about global warming is very important for students to have.

The government has developed a three-pronged strategy to improve students' scientific literacy: modifying the physical environment to facilitate literacy; attempting to establish a social and effective environment that serves as a model for literate interaction and communication; and attempting to transform schools into an academic environment system—the educated (économiques, 2019; OECD, 2021). Nevertheless, the government's approach does not go into great detail regarding pupils' scientific literacy skills. Using scientific literacy ability assessment tools is one way to both define and enhance students' scientific literacy abilities. Through this research, it can provide an overview of students' profiles regarding scientific literacy abilities. Additionally, scientific literacy ability assessment instruments on global warming material can help students learn and familiarize themselves with phenomena related to scientific literacy. This research aims to determine the profile of students' scientific literacy abilities in global warming material with the help of Rasch Model analysis.

▪ METHOD

Design Study

The descriptive quantitative research method is the method used in this research. Research using descriptive quantitative analysis is a method that can provide accurate, reliable, and good results from the data collected (Duckett, 2021). This research was conducted with the following steps, 1) developing the question instrument, 2) testing the questions on students using google form, 3) analysing the results, and 4) interpreting the results. Excel, winstep, and notepad are the tools used to process data. Then, the results obtained are described in detail according to the results of field conditions.

Participant

The participants in this study were 15 students (4 boys and 11 girls) from a senior high school in Surabaya, East Java. Each participant is a senior high school student in grade XII and uses the 2013 Indonesian Curriculum. The location of this study is presented in Figure 1.

Figure 1. The distribution of participants

Instrument

This study uses 10 multiple-choice questions and is equipped with reasons for choosing the answer as an open column. The question instruments consisted of three science literacy aspects: context, knowledge, and competence. Experts validated the questions and then tested for validity and reliability using the Rasch model analysis. The validated questions were put into a Google form to be given to students. The questions tested are presented in Figure 2.

Segala sumber energi yang terdapat di Bumi berasal dari Matahari. Sebagian besar energi tersebut dalam bentuk radiasi gelombang pendek, termasuk cahaya tampak. Ketika energi ini mengenai permukaan Bumi, ia berubah dari cahaya menjadi panas yang menghangatkan Bumi. Permukaan Bumi, akan menyerap sebagian panas dan memantulkan kembali sisanya. Sebagian dari panas ini sebagai radiasi infra merah gelombang panjang ke angkasa luar. Namun sebagian panas tetap terperangkap di atmosfer bumi akibat menumpuknya jumlah gas rumah kaca antara lain uap air, karbon dioksida, dan metana yang menjadi perangkap gelombang radiasi ini. Gas-gas ini menyerap dan memantulkan kembali radiasi gelombang yang dipancarkan Bumi dan akibatnya panas tersebut akan tersimpan di permukaan Bumi. Hal tersebut terjadiberulang-ulang dan mengakibatkan suhu rata-rata tahunan bumi terus meningkat. Gas-gas tersebut berfungsi sebagaimana kaca dalam rumah kaca. Dengan semakin meningkatnya konsentrasi gas gas ini di atmosfer, semakin banyak panas yang terperangkap di bawahnya. Sebenarnya, efek rumah kaca ini sangat dibutuhkan oleh segala makhluk hidup yang ada di bumi, karena tanpanya, planet ini akan menjadi sangat dingin. Dengan temperatur rata-rata sebesar 15 °C (59 °F), bumi sebenarnya telah lebih panas 33 °C (59 °F) dengan efek rumah kaca (tanpanya suhu bumi hanya -18 °C sehingga es akan menutupi seluruh permukaan Bumi). Akan tetapi sebaliknya, akibat jumlah gas-gas tersebut telah berlebih di atmosfer, pemanasan global menjadi akibat. Berdasarkan bacaan tersebut, apakah gas rumah kaca memiliki manfaat bagi bumi.

A. Tidak bermanfaat karena menimbulkan pemanasan global
B. Bermanfaat untuk menghangatkan bumi
C. Tidak berpengaruh apapun pada bumi
D. Tidak bermanfaat karena membuat bumi menjadi dingin
E. Bermanfaat karena membuat bumi menjadi dingin

Alasan
.....
.....

All energy sources on Earth come from the Sun. Most of this energy is in the form of shortwave radiation, including visible light. When this energy hits the Earth's surface, it changes from light to heat which warms the Earth. The Earth's surface will absorb some of the heat and reflect the rest back. Some of this heat goes as long-wave infrared radiation into outer space. However, some of the heat remains trapped in the earth's atmosphere due to the buildup of greenhouse gases, including water vapor, carbon dioxide and methane, which trap these radiation waves. These gases absorb and reflect back the wave radiation emitted by the Earth and as a result the heat will be stored on the Earth's surface. This happens repeatedly and causes the earth's average annual temperature to continue to increase. These gases function like glass in a greenhouse. As the concentration of these gases increases in the atmosphere, more heat is trapped beneath them. In fact, this greenhouse effect is really needed by all living things on earth, because without it, this planet would be very cold. With an average temperature of 15 °C (59 °F), the earth is actually 33 °C (59 °F) hotter due to the greenhouse effect (without which the earth's temperature would only be -18 °C so ice would cover the entire surface of the Earth). However, on the contrary, due to the excessive amount of these gases in the atmosphere, global warming is the result. Based on this reading, do greenhouse gases have any benefits for the earth?

A. It is not useful because it causes global warming
B. Useful for warming the earth
C. It does not affect whatsoever on the earth
D. It is not useful because it makes the earth cold
E. It is useful because it makes the earth cool

Reason
.....
.....

Figure 2. An example of a question

Data Analysis

The data analyzed were the results of expert validity and student responses to the questions answered. After that, the data analysis process continued using the Rasch Model analysis to determine the validity of the question (unidimensionality), reliable person, reliable item, and logit item and logit person. The data analyzed were the results of expert validity and student responses to the questions answered. Interpretation of the results is presented (Sumintono & Widhiarso, 2014a): instrument validity (Table 1), reliable person and item (Table 2), logit person, and logit item (Table 3).

Table 1. Interpretation of instrument validity

Interpretation	Raw variance explained by measures
Fulfilled	>20%
In accordance	>40%
Special	>60%

Table 2. Interpretation of reliability item and person

Value Range	Interpretation
Value ≥ 0.95	Excellent
0.95 > value ≥ 0.91	Very Good
0.91 > value ≥ 0.81	Good

0.81 > value ≥ 0.68	Moderate
0.68 > value	Weak

Tabel 3. Interpretation logit value

Item Logit Value (A)	Criteria	Person Logit Value (B)	Criteria
A ≥ +1.37	Very difficult	B ≥1.80	Height
0.0 ≥ A ≤ + 1.37	Difficult	B ≤ 1.80	Currently
0.0 ≤ A ≥ – 1.37	Currently	B ≤ -1,29	Low
A ≤ – 137	Easy		

▪ RESULT AND DISSCUSSION

The results of this research present several sub-chapters to explain in detail and answer the research questions conducted. The discussion and analysis of data use the help of the Rasch Model so that human error can be anticipated in analyzing research results. Further details are presented as follows.

Instrument Validity with Unidimensionality

One instrument assessment that can be carried out in analyzing the level of validity of the question instruments created is unidimensionality (Clark & Watson, 2019; Raof et al., 2021). This analysis states whether the instrument that researchers have developed can measure what it should measure, in this case, the scientific literacy profile of students. The unidimensionality results are presented in Figure 3.

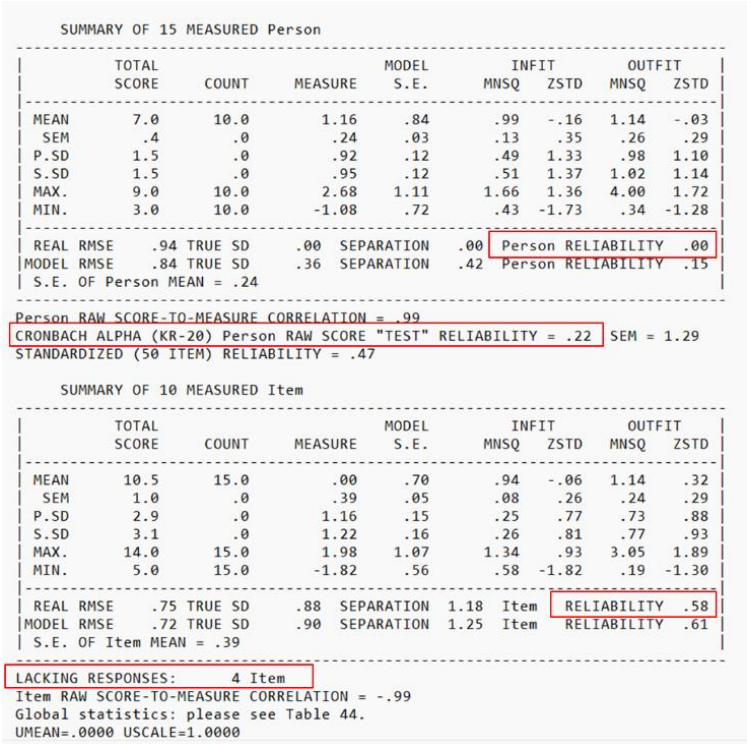
```
Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units
                                    Eigenvalue   Observed   Expected
Total raw variance in observations     =      14.7183 100.0%          100.0%
  Raw variance explained by measures   =       4.7183  32.1%           29.1%
    Raw variance explained by persons  =       1.8355  12.5%           11.3%
    Raw Variance explained by items    =       2.8828  19.6%           17.8%
  Raw unexplained variance (total)     =      10.0000  67.9% 100.0%    70.9%
    Unexplned variance in 1st contrast =       3.2498  22.1%  32.5%
```

Figure 3. Validity instrument results

Based on Figure 3, it can be seen that the validity measurement results refer to the raw variance explained by the measured value of 32.1% with the criteria being met because it is greater than 20% (see Table 1). This means that the instrument can be said to be suitable for use in further research if viewed from the unidimensionality aspect. According to Hagell, (2014), Rasch Model analysis uses Principal Component Analysis of residual values which can measure the diversity of instruments developed to measure something that must be measured. Apart from that, there is an unexplained variance of 22.1%. According to Sumintono, (2018), the instrument developed and tested should ideally have unexplained variance not exceeding 15%, however, the results obtained in this study are in a fairly wide range. Therefore, to find out what factors are the causes of why this happens, we must look further into the item and person reliability tests.

Instrument reliability item and person

In this section, item and person analysis can provide information on the reliability of the question items, person reliability, and the relationship between item-person reliability on the instrument being developed. The following results are presented in Figure 4.



SUMMARY OF 15 MEASURED Person

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	7.0	10.0	1.16	.84	.99	-.16	1.14	-.03
SEM	.4	.0	.24	.03	.13	.35	.26	.29
P.SD	1.5	.0	.92	.12	.49	1.33	.98	1.10
S.SD	1.5	.0	.95	.12	.51	1.37	1.02	1.14
MAX.	9.0	10.0	2.68	1.11	1.66	1.36	4.00	1.72
MIN.	3.0	10.0	-1.08	.72	.43	-1.73	.34	-1.28

REAL RMSE .94 TRUE SD .00 SEPARATION .00 Person RELIABILITY .00
MODEL RMSE .84 TRUE SD .36 SEPARATION .42 Person RELIABILITY .15
S.E. OF Person MEAN = .24

Person RAW SCORE-TO-MEASURE CORRELATION = .99
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .22 SEM = 1.29
STANDARDIZED (50 ITEM) RELIABILITY = .47

SUMMARY OF 10 MEASURED Item

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	10.5	15.0	.00	.70	.94	-.06	1.14	.32
SEM	1.0	.0	.39	.05	.08	.26	.24	.29
P.SD	2.9	.0	1.16	.15	.25	.77	.73	.88
S.SD	3.1	.0	1.22	.16	.26	.81	.77	.93
MAX.	14.0	15.0	1.98	1.07	1.34	.93	3.05	1.89
MIN.	5.0	15.0	-1.82	.56	.58	-1.82	.19	-1.30

REAL RMSE .75 TRUE SD .88 SEPARATION 1.18 Item RELIABILITY .58
MODEL RMSE .72 TRUE SD .90 SEPARATION 1.25 Item RELIABILITY .61
S.E. OF Item MEAN = .39

LACKING RESPONSES: 4 Item
Item RAW SCORE-TO-MEASURE CORRELATION = -.99
Global statistics: please see Table 44.
UMEAN=.0000 USCALE=1.0000

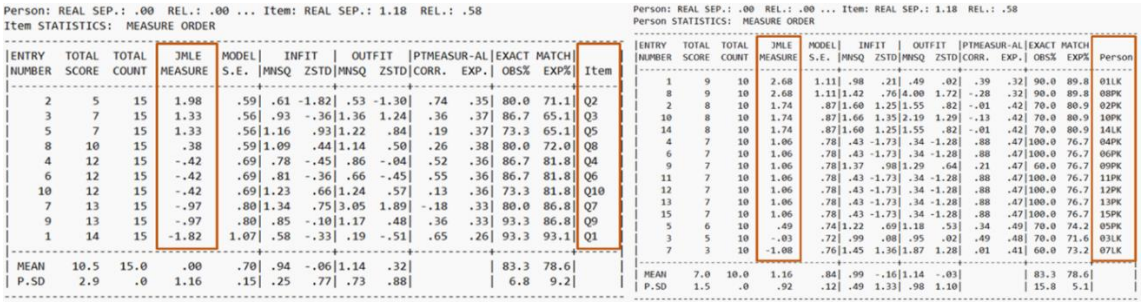
Figure 4. Reliability instrument item-person

Figure 4 presents reliable information about person-items and the relationship between person-items through Cronbach's alpha value. Person reliability gets a score of 0.00 with unreliable criteria, while item reliability gets a score of 0.58 with weak criteria. This states that the consistency of students' answers is inconsistent and the quality of the item instruments is in the weak category. That way, through the Cronbach Alpha value we can find out the relationship between the reliability of the item and the person as a whole (Hayes & Coutts, 2020; Taber, 2018). The results presented state that the value of 0.22 is in the bad category. In this way, the instrument developed is included in the bad category for measuring students' literacy skills. Apart from that, in the summary of items section, a lack of response was detected on 4 question items. This states that the level of students' abilities in literacy differs from one to another. Therefore, the profile of students' literacy abilities, can be traced based on the logit value.

Logit Item and Person Measure

This analysis presents the level of students' literacy abilities and the level of difficulty of each item. This can also be the basis for the validity and reliability results discussed previously (Chan et al., 2021; Ludlow & Haley, 1995; Tennant & Conaghan,

2007). Therefore, further analysis of item and person logit values is necessary to clarify previous results. The following logit value results are presented in Figure 5.



Person: REAL SEP.: .00 REL.: .00 ... Item: REAL SEP.: 1.18 REL.: .58
Item STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE 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
2	5	15	1.98	.59	.61	-1.82	.53	-1.30	.74	.35	80.0	71.1	Q2
3	7	15	1.33	.56	.93	-.36	1.36	1.24	.36	.37	86.7	65.1	Q3
5	7	15	1.33	.56	1.16	.93	1.22	.84	.19	.37	73.3	65.1	Q5
8	10	15	.38	.59	1.09	.44	1.14	.50	.26	.38	80.0	72.0	Q8
4	12	15	-.42	.69	.78	-.45	.86	-.04	.52	.36	86.7	81.8	Q4
6	12	15	-.42	.69	.81	-.36	.66	-.45	.55	.36	86.7	81.8	Q6
10	12	15	-.42	.69	1.23	.66	1.24	.57	.13	.36	73.3	81.8	Q10
7	13	15	-.97	.80	1.34	.75	3.05	1.89	-.18	.33	80.0	86.8	Q7
9	13	15	-.97	.80	.85	-.10	1.17	.48	.36	.33	93.3	86.8	Q9
1	14	15	-1.82	1.07	.58	-.33	.19	-.51	.65	.26	93.3	93.1	Q1
MEAN	10.5	15.0	.00	.70	.94	-.06	1.14	.32			83.3	78.6	
P.SD	2.9	.0	1.16	.15	.25	.77	.73	.88			6.8	9.2	

Person: REAL SEP.: .00 REL.: .00 ... Item: REAL SEP.: 1.18 REL.: .58
Person STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Person
1	9	10	2.68	1.11	.98	.21	.49	.02	.39	.32	90.0	89.8	01LK
8	9	10	2.68	1.11	1.42	.76	4.00	1.72	-.28	.32	90.0	89.8	08PK
2	8	10	1.74	.87	1.60	1.25	1.55	.82	-.01	.42	70.0	80.9	02PK
10	8	10	1.74	.87	1.66	1.35	2.19	1.29	-.13	.42	70.0	80.9	10PK
14	8	10	1.74	.87	1.60	1.25	1.55	.82	-.01	.42	70.0	80.9	14LK
4	7	10	1.06	.78	.43	-1.73	.34	-1.28	.88	.47	100.0	76.7	04PK
6	7	10	1.06	.78	.43	-1.73	.34	-1.28	.88	.47	100.0	76.7	06PK
9	7	10	1.06	.78	1.37	.98	1.29	.64	.21	.47	60.0	76.7	09PK
11	7	10	1.06	.78	.43	-1.73	.34	-1.28	.88	.47	100.0	76.7	11PK
12	7	10	1.06	.78	.43	-1.73	.34	-1.28	.88	.47	100.0	76.7	12PK
13	7	10	1.06	.78	.43	-1.73	.34	-1.28	.88	.47	100.0	76.7	13PK
15	7	10	1.06	.78	.43	-1.73	.34	-1.28	.88	.47	100.0	76.7	15PK
5	6	10	.49	.74	1.22	.69	1.18	.53	.34	.49	70.0	74.2	05PK
3	5	10	-.03	.72	.99	.08	.95	.02	.49	.48	70.0	71.6	03LK
7	3	10	-1.08	.76	1.45	1.36	1.87	1.28	.01	.41	60.0	73.2	07LK
MEAN	7.0	10.0	1.16	.84	.99	-.16	1.14	-.03			83.3	78.6	
P.SD	1.5	.0	.92	.12	.49	1.33	.98	1.10			15.8	5.1	

Figure 5. Item and person logit values

Through the logit values obtained according to Figure 5, students' literacy abilities and the level of difficulty of the questions can be analyzed in depth (see Table 3). In the logit items, the question with the highest level of difficulty is Q2 with a logit value of 1.98 (very difficult) while the easiest question is Q1 with a logit value of -1.82 (easy). Then for students who have very high literacy skills, namely 01LK and 08PK with a digit value of 2.68 (height) respectively, while the student's literacy skills are very weak, namely 07LK with a logit value of -1.08 (low). This can clarify that the reliability of the questions created also has an impact on students' literacy abilities. The mapping of students' literacy abilities with questions is presented in Figure 6.

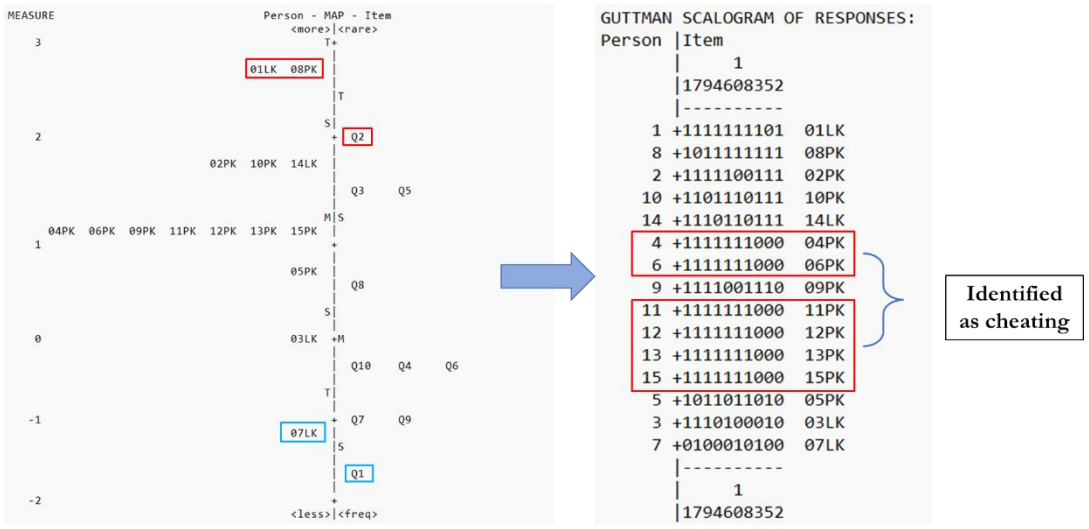


Figure 6. Mapping student profiles and question items

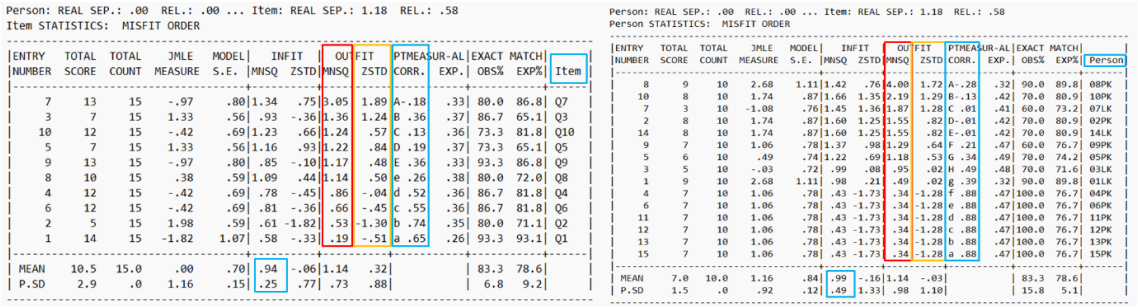
Based on Figure 6, it can be seen that the level of literacy skills of students and the level of difficulty of the questions they can answer. If we look at students with codes 01KL and 08PK, they have very high abilities and can answer all the questions. However, there are still errors in both questions Q5 and Q2. In the question items section, Q2 is the most difficult question and is followed by questions Q3 and Q5. From the mapping presented, it turns out that there is potential for cheating in answering literacy questions. This is obtained through further analysis of the scalogram which maps the correct and

incorrect questions answered by students. Students with codes O4PK, 06PK, 11PK, 12PK, 13PK, and 15PK have the same answer pattern with correct and incorrect scores of 7 and 3 respectively. From this pattern, it is predicted that these students are cheating or cheating on each other. other. This is reinforced by the fact that all those with the same answer pattern are women, allowing them to be in the same group.

Then, students with code 07LK were only able to answer three questions correctly and the rest incorrectly. If traced, the literacy skills of the 07LK students are in a very low category with the only question item that can be answered being Q1 which is the easiest question item. On the other hand, the correct question is predicted to be the original result in answering so it is luck to be correct. According to Spiro et al. (2013), students' literacy abilities can be measured through three aspects, namely content, cognitive processes, and context. However, in this case, the question presentation refers more to content and cognitive progress.

Item-Person Fit Order

This analysis has a role in analyzing the suitability of items and people known as outliers. In this analysis three main components can be used as a basis for deciding whether to accept or not, namely, (1) MNSQ is accepted if, 0.5<MNSQ<1.5, (2) ZSTD is accepted if, -2.0<ZSTD<+2.0, and (3) Pt mean Corr is accepted if, 0.4 <Pt Mean Corr<0.85 (Sumintono & Widhiarso, 2014b). The results are presented in Figure 7



Person: REAL SEP.: .00 REL.: .00 ... Item: REAL SEP.: 1.18 REL.: .58
Item STATISTICS: MISFIT ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE 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
7	13	15	-.97	.80	1.34	.75	3.05	1.89	A	-.18	.33	80.0	86.8	Q7
3	7	15	1.33	.56	.93	-.36	1.36	1.24	B	.36	.37	86.7	65.1	Q3
10	12	15	-.42	.69	1.23	.66	1.24	.57	C	.13	.36	73.3	81.8	Q10
5	7	15	1.33	.56	1.16	.93	1.22	.84	D	.19	.37	73.3	65.1	Q5
9	13	15	-.97	.80	.85	-.10	1.17	.48	E	.36	.33	93.3	86.8	Q9
8	10	15	.38	.59	1.09	.44	1.14	.50	e	.26	.38	80.0	72.0	Q8
4	12	15	-.42	.69	.78	-.45	.86	-.04	d	.52	.36	86.7	81.8	Q4
6	12	15	-.42	.69	.81	-.36	.66	-.45	c	.55	.36	86.7	81.8	Q6
2	5	15	1.98	.59	.61	-1.82	.53	-1.30	b	.74	.35	80.0	71.1	Q2
1	14	15	-1.82	1.07	.58	-.33	.19	-.51	a	.65	.26	93.3	93.1	Q1
MEAN	10.5	15.0	.00	.70	.94	-.06	1.14	.32			83.3	78.6	
P.SD	2.9	.0	1.16	.15	.25	.77	.73	.88			6.8	9.2	

Person: REAL SEP.: .00 REL.: .00 ... Item: REAL SEP.: 1.18 REL.: .58
Person STATISTICS: MISFIT ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Person
8	9	10	2.68	1.11	1.42	.76	4.00	1.72	A	-.28	.32	90.0	89.8	08PK
10	8	10	1.74	.87	1.66	1.35	2.19	1.29	B	-.13	.42	70.0	80.9	10PK
7	3	10	-1.08	.76	1.45	1.36	1.87	1.28	C	.01	.41	60.0	73.2	07LK
2	8	10	1.74	.87	1.60	1.25	1.55	.82	D	-.01	.42	70.0	80.9	02PK
14	8	10	1.74	.87	1.60	1.25	1.55	.82	E	-.01	.42	70.0	80.9	14LK
9	7	10	1.06	.78	1.37	.98	1.29	.64	F	.21	.47	60.0	76.7	09PK
5	6	10	.49	.74	1.22	.69	1.18	.53	G	.34	.49	70.0	74.2	05PK
3	5	10	-.03	.72	.99	.08	.95	.02	H	.49	.48	70.0	71.6	03LK
1	9	10	2.68	1.11	.98	.21	.49	.02	g	.39	.32	90.0	89.8	01LK
4	7	10	1.06	.78	.43	-1.73	.34	-1.28	f	.88	.47	100.0	76.7	04PK
6	7	10	1.06	.78	.43	-1.73	.34	-1.28	e	.88	.47	100.0	76.7	06PK
11	7	10	1.06	.78	.43	-1.73	.34	-1.28	d	.88	.47	100.0	76.7	11PK
12	7	10	1.06	.78	.43	-1.73	.34	-1.28	c	.88	.47	100.0	76.7	12PK
13	7	10	1.06	.78	.43	-1.73	.34	-1.28	b	.88	.47	100.0	76.7	13PK
15	7	10	1.06	.78	.43	-1.73	.34	-1.28	a	.88	.47	100.0	76.7	15PK
MEAN	7.0	10.0	1.16	.84	.99	-.16	1.14	-.03			83.3	78.6	
P.SD	1.5	.0	.92	.12	.49	1.33	.98	1.10			15.8	5.1	

Figure 7. Item-person fit order

Figure 7 presents the results of misfit mapping between person and item to measure students' literacy abilities. In the item section, the number of item logits from the mean and standard deviation is obtained: 0.94 + 0.25 = 1.19. In this section, the researcher uses the ZSTD criteria so that it can be obtained that all fit order items are accepted because they are between the values ZSTD. This indicates that all question items are still acceptable. Then look at students' abilities referring to grades ZSTD is also in the accepted category, namely between +2.0 and -2.0. That way, between items and people there is no misfit when viewed from the value ZSTD. However, a deeper review was carried out using the MNSQ value, where item Q7 had a value of 3.05, which is an outlier value, while the other items were in the accepted category. At the same time, for one person, there were two students with scores above 1.5, namely 08PK (4.00) and 10PK (2.19) which means the two students have different abilities from other students.

▪ CONCLUSION

The results of this research reveal the validity and reliability of the instruments that have been developed to determine students' profiles in scientific literacy abilities. The questionnaire that was developed found a relationship between items and persons through a Cronbach's alpha result of 0.22 and was included in the poor category, so improvements were needed for the instrument before conducting wider trials. Apart from that, students' literacy skills are highest with code 01LK and 08PK is at the highest logit value which is above the most difficult question, namely Q2. Apart from that, students with very low literacy skills with code 07LK obtained a logit value of -1.00 while the youngest question was question number one with code Q1. Therefore, it is necessary to improve the questions on the instrument being developed so that it is valid and reliable to be applied to a wider group because the number of questions that are above the logit value of 0 is only four questions with the respective codes Q2, Q3, Q5, and Q8.

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