

BUKTI KORESPONDENSI
ARTIKEL JURNAL INTERNASIONAL BEREPUTASI

Judul Artikel : [A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability](#)

Jurnal : International Journal of Interactive Mobile Technologies (IJIM)
Volume 13/ Nomor 7/ Tahun 2019

Penulis : **Mustika Wati**, Saiyidah Mahtari, Sri Hartini, Heny Amelia

Afiliasi : Universitas Lambung Mangkurat

No.	Perihal	Tanggal
1.	Bukti submit melalui OJS	29 April 2019
2.	Bukti konfirmasi submission dari iJIM via e-mail	7 May 2019
3.	Bukti status 'in review' pada OJS	8 May 2019
4.	Resubmitted after review melalui OJS	4 Juni 2019
5.	Final acceptance (mention in the article by iJIM)	7 Juni 2019
6.	Final version published (mention in online version)	11 Juli 2019

**1. Bukti submit melalui
OJS
(29 April 2019)**

ICITE 2018 - Impo... x 7K7 Active Submission... x Perceptions and I... x [JIM] Validate Yo... x Register x Google Terjemah... x ORCID x

https://online-journals.org/index.php/i-jim/author/saveSubmit/5

iJIM International Journal of Interactive Mobile Technologies

HOME ABOUT USER HOME SEARCH CURRENT ARCHIVES ANNOUNCEMENTS

Home > User > Author > Submissions > Active Submissions


Active Submissions

Submission complete. Thank you for your interest in publishing with International Journal of Interactive Mobile Technologies (IJIM).

- [Active Submissions](#)

International Journal of Interactive Mobile Technologies (IJIM) - eISSN: 1865-7923

Indexing:



FONT SIZE

USER

You are logged in as... sayyidah

- [My Journals](#)
- [My Profile](#)
- [Log Out](#)

JOURNAL CONTENT

Search

Search Scope

All

Search

Browse

- [By Issue](#)
- [By Author](#)
- [By Title](#)
- [Other Journals](#)

INFORMATION

3:49 PM 4/29/2019

1570446320.doc

by

Submission date: 20-Aug-2018 02:32PM (UTC+0800)

Submission ID: 991439593

File name: 1570446320.doc (185.5K)

Word count: 3521

Character count: 19413

A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability

Mustika Wati¹, Saiyidah Mahtari¹, Sri Hartini, Heny Amalia¹

Physics Education Study Program
FKIP Universitas Lambung Mangkurat
Indonesia

mustika_pfis@ulm.ac.id, saiyidah_pfis@ulm.ac.id, srihartini_pfis@ulm.ac.id

Abstract: Science education that emphasizes only the count is not relevant at the moment. Students must make scientific reasoning in answering the problem. This study aims to determine students' scientific reasoning abilities in the light matter. The method in this research was the descriptive method by using survey technique. The instrument used is a description test consisting of 8 items of light matter. This test was conducted on 201 students from the eighth-grade junior high school in Banjarmasin selected at random. The RASCH model is used as a processing stage of data from raw data into logit numbers that provide information related to infit, outfit and unidimensionality using a winstep program to achieve this goal, this study investigated the quality of items from Item and person measure, Item Bias, item and person reliability, and variable map. The findings show that the scientific reasoning ability of the eighth-grade students can be at a low level. So researchers should strive to improve students' scientific reasoning abilities in future research.

Keywords *Keywords* – Rasch Model; construct validity; test; scientific reasoning.

Introduction: Physics can be interpreted as a science of measurement because everything we know about the world of physics and the principles governing its behaviour has been studied through observations of natural phenomena. Physics is a science that requires more understanding than shipping (Siregar, 2003). The purpose of learning physics is the formation of reasoning ability in students reflected through the ability to think logically, critically, and systematically in problems solving, especially in the field of physics (Rangkuti, 2015). In the Curriculum 2013, it is explained that one of the core competencies in learning, especially for grades VIII and IX SMP is to cultivate, decorate, and reason in the realm of concrete and abstract realms as studied in schools and other sources in the same point of view/theory.

Scientific reasoning is one of the 21st-century skills that is expected to be taught in the science classroom in an effort to prepare students for their success in facing the challenges of globalization. Scientific reasoning is highly emphasized in new science education standards (Zhou, et al., 2014). In the PISA test, the skill is also one of the skills tested (Salz, 2009). The Scientific reasoning could be an effective predictor of student success and thus could potentially be used in practical decision making for the course (Thompson, et al., 2018). Students who are used to solve problems indirectly develop the thought process of reasoning (Rizta et al., 2013). In a series of studies, they showed that the scientific reasoning of preadolescent children was severely deficient (Kuhn & Franklin, 2006).

Georg Rasch developed an analytical model of the response theory of grains (or Item Response Theory, IRT) in the 1960s (Boone et al., 2011). IRT is an alternative test measurement theory in addition to Classical test theory. Classical tests of these theories enable the presumption of test results such as the difficulty of items and the ability of people. IRT focuses on the pattern of responses given by the person to the test item and background person. IRT has many advantages and is more complex than Classical test theory (Chan et al., 2013). Rasch measurement model or one parameter model is the simplest IRT model and it has strong measurement properties (Afrassa, 2005). Raw data in the form of dichotomous data (in the form of right and wrong) that indicate students' abilities, Rasch formulates this into a model that connects students and item (Sumintono and Widhiarso, 2014). The benefit of Rasch's analysis is its

46 ability to estimate the total score for clients even when not all items have been managed. This is
47 especially useful when working with children who may not adhere to all the constraints of standard
48 testing situations (Avery et al., 2003).

49 Scientific reasoning is very important for students, it is related to the role of scientific reasoning in the
50 process of solving problems in physics. Thus, this study was conducted to describe the students'
51 scientific reasoning abilities using the Rasch measurement model

52 **Methodology:** The method in this research was the descriptive method by using survey technique. In
53 this study, the participant was 201 eighth grade students from 3 junior high schools in Banjarmasin.
54 They were chosen at random. Their age was between 14-15 years old. The study was conducted in April
55 2017. All participants had studied light material before the test. The instrument used in this study is a
56 scientific reasoning test on light material with 8 questions. The purpose of this test was to test students'
57 scientific reasoning abilities. Students are given time to answer the test for eighty minutes. The test
58 results are then used as data in this study. Each student is labelled with codes A, B and C for the
59 representation of the origin of the school. The description described students' reasoning abilities gained
60 after students completed the reasoning ability of reasoning instruments on the Light material. The result
61 data will be included in the winstep software which is one of the series in Rasch model with the data
62 polytomy. Output in this software that is in the form of the Item Measure table, Person Measure,
63 Variable Maps and Reliability which have been converted before becoming a logit number. This logit
64 number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure
65 Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling.

66 Output winstep is in the form of Item Measure table, Person Measure, Variable Maps and Reliability
67 which have been converted before becoming logit number. This logit number must qualify the Mean
68 Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and
69 Reliability values according to Rasch modelling. The parameters used are infit and outfit of the mean
70 square and standardized values. According to Sumintono and Widhiarso (2014), infit (inlier sensitive or
71 information weighted fit) is the sensitivity of response pattern to target item on respondent (person) or
72 vice versa; while outfit (outlier sensitive fit) measures the sensitivity of the response pattern to the item
73 with a certain degree of difficulty on the respondent or vice versa. According to Sumintono and
74 Widhiarso (2015) of the logit numbers obtained from the Ministep software output, there is an interval
75 scale (logit rule) which describes the state of the number. The scale is:

- 76 1. The value of Mean Square Outfit (MNSQ) received: $0.5 < \text{MNSQ} < 1.5$
77 2. The accepted Z-Standard Output (ZSTD) value: $-2.0 < \text{ZSTD} < +2.0$
78 3. Point Measure Correlation Value (Pt Mean Corr): $0.4 < \text{Pt Measure Corr} < 0.85$

79 Therefore, the respondent would be qualified based on the value relating to the entry and absence of
80 respondents in the modelling. Reliability questions with Rasch modelling were analyzed using individual
81 separation values and grain separations as well as Cronbach Alpha values displayed in Rasch program
82 outputs. The higher the value of individual separation and the value of the grain separation and the
83 Alpha Cronbach value the better the reliability of the problem. The criteria for interpreting the value of
84 individual separation and the separation of an instrument's grain can be seen using Table 1 (Sumintono
85 and Widhiarso, 2015).

Criteria	Value of separation individual and item
Weak	<0,67
Enough	0,67-0,80
Nice	0,81-0,90
Very Good	0,91-0,94
Special	>0,94

86 Table 1. Interpretation of individual separation values and Instrument separation items

87 The Cronbach Alpha values used to measure interactions between individuals with whole grains can be
88 interpreted using Table 2 (Sumintono and Widhiarso, 2015).

Criteria	Alpha Cronbach
<i>Bad</i>	< 0,5
<i>Ugly</i>	0,5 – 0,6
<i>Enough</i>	0,6 – 0,7
<i>Nice</i>	0,7 – 0,8
<i>Very Good</i>	>0,8

89

Table 2 Interpretation of Cronbach Alpha values

90 Problem level of difficulty with Rasch modelling is analyzed by using logit number contained in the
 91 measurement column problem, the higher the logit value than the higher the difficulty level of the
 92 problem. In the measurement of the problem, there is also information on the standard deviation value.
 93 If the value is combined with an average logit score, the difficulty level of the items can be grouped
 94 according to the difficulty level as in Table 3 (Sumintono and Widhiarso, 2015).

Interpretation	Criteria
<i>Difficult</i>	0,00 logit + 1SD
<i>Very Difficult</i>	>+ 1SD
<i>Easy</i>	0,00 logit – 1SD
<i>Very Easy</i>	<- 1SD

95

Table 3. Interpretation of Problem Exchange Index

96 **Result and discussion:**

Item number	Infit		Outfit		PT-Measure		Prob	Measure
	MNSQ	ZSTD	MNSQ	ZSTD	CORR	EXP		
1	1.15	1.5	1.15	0.8	0.59	0.64	0.4915	-0.81
2	1.03	0.3	0.92	-0.6	0.68	0.67	0.0001	-0.26
3	0.79	-2.0	0.81	-1.7	0.69	0.65	0.2022	0.13
4	1.05	0.5	1.22	1.5	0.55	0.6	0.5853	-0.20
5	0.61	-2.8	0.6	-2.7	0.77	0.7	0.2197	0.64
6	0.5	-4.1	0.52	-3.7	0.81	0.71	0.4565	0.63
7	1.38	2.7	1.47	2.7	0.49	0.58	0.0031	-0.14
8	1.18	1.3	1.29	1.6	0.6	0.63	0.0111	0.01
S.D								0.45
<i>Person Reliability</i> 0.79								
<i>Item Reliability</i> 0.99								
<i>Cronbach Alpha</i> 0.85								

97

Table 4. Results summary of the winstep program output

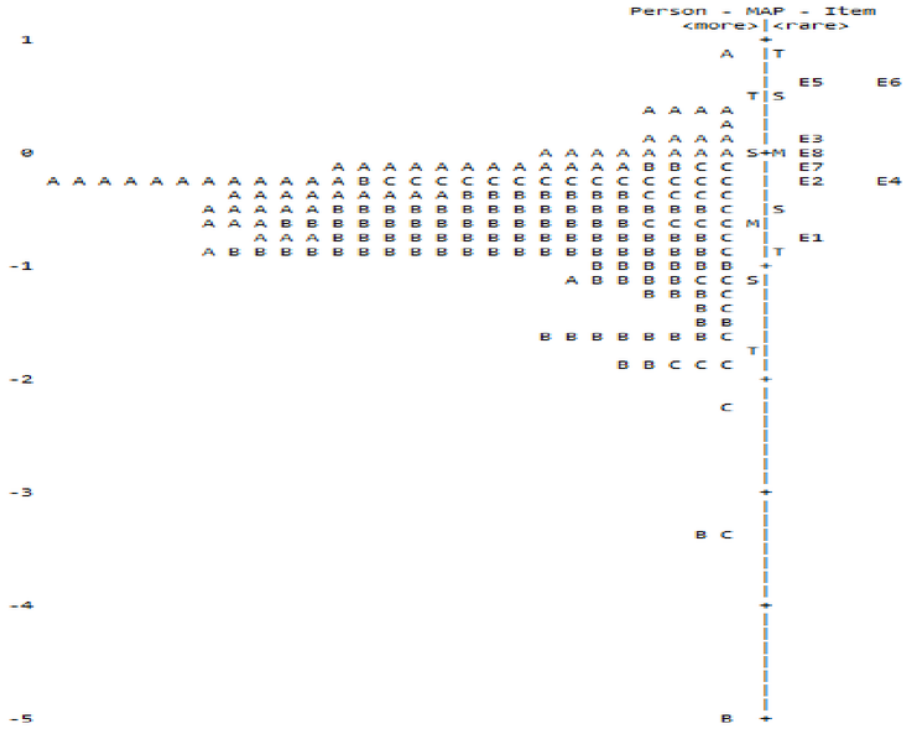


Figure 1. Variable Map

100

101 Based on Table 4, it can be seen that the top item is item 7 has a tendency that is less fit. When viewed
 102 from three criteria, item 7 only does not qualify at ZSTD outfit value that was equal to 2.7 or
 103 unpredictable data, but for MNSQ outfit value that was equal to 1.47 still, meet good criteria for
 104 measurement. The value of Pt Measure Corr also meets the criteria of 0.49. Therefore, item 7 can be
 105 maintained and did not need to be fixed. This is similar to the items 5 and 6 that have ZSTD values of -
 106 2.7 and -3.7 or too small, so data was too predictable but can still be maintained to measure students'
 107 reasoning abilities. As for the items other items have the value of MNSQ, ZSTD, and Pt Measure Corr in
 108 accordance with the criteria so it does not need to be repaired. However, according to Sumintono and
 109 Widhiarso (2015), the value of the grain conformity consisting of Outfit MNSQ, ZSTD, and Pt Measure
 110 Corr is strongly influenced by the size of the sample size.

111 A point item is called bias if it is found that one individual with a particular characteristic is more
 112 favourable than that of an individual with another characteristic (Sumintono and Widhiarso 2015). An
 113 item is said to contain bias if it is found that the probability value of the item is below 5%. In Rasch
 114 modelling to detect the biased problem can be seen in Table 4. There were 3 items that are biased and 5
 115 items are unbiased. So, there were 5 items that can be directly used to measure students' reasoning
 116 ability and 3 items that need to be improved in order to make good measurements was items 2,7 and 8.
 117 This indicates that these three items need to be improved so as not to harm a particular school.

118 Reliability problems developed for the criteria of person reliability into the category was nice, the
 119 criteria of the reliability of the item entry into the category special, and Cronbach Alpha criteria into the
 120 category of very good Thus, overall these questions can be trusted to measure students' reasoning
 121 abilities. It also shows that the reliability of the items was very good. In table 4, it can be seen in the
 122 Item Number column that item 5 was the hardest problem with a logit value of 0.64 and question
 123 number 1 was the easiest problem with a logit value of -0.81, it corresponds to the cognitive domain of
 124 the reasoning problem developed. Items 5, 6, and 3 had Cognitive domains C5, items 8, 7, and 4 had C4
 125 cognitive domains, and item 1 has C3 cognitive domains. Item 2 had Cognitive domain C5, but it was not

126 in accordance with the results of research analysis that shows the problem is entered in the category
127 very easily with a logit value of -0.26. It was also shown by the number of students who can correctly
128 answer the question.

129 The variable map shows the distribution of student ability and item difficulty on the same logit scale.
130 Students' abilities are listed on the left side of the map while the item difficulty is on the right side of the
131 map. The higher logit represents students with higher abilities (the left side) and more difficult items
132 (right side) and vice versa (Iramaneerat, Smith, and Smith, 2008). Through the variable map, it allows us
133 to identify whether the item matches the student's abilities. The relation of ability possessed by
134 students with problem level in figure 1, on the left side shows the distribution of students' reasoning
135 ability and the right side shows the difficulty level of the item. The left side of the map shows the higher
136 level of the reasoning problem. This means the student could get the maximum value of all questions.

137 On the right side of the map are eight items that have difficulty levels that from item 5 was the most
138 difficult to item1 the easiest to do. This means that there is no problem that accumulates in one line
139 only, it shows the problem of having various levels of difficulty, ranging from the most difficult to the
140 easiest. Logit 0 is set as the average test item (Iramaneerat, Smith, and Smith, 2008). From the variable
141 map, we can see that most students are below the average of the exam items. Few students with higher
142 abilities are above logit 0 and very many students are below average. Low logit indicates low ability.
143 Thus we can argue that the students' ability in scientific reasoning is low, as most of them cannot solve
144 the problem of scientific reasoning. In other words, items are deemed less able to fit the student's
145 abilities. This is because students are not familiar with the scientific reasoning items in this study and
146 they are not taught to answer these kinds of questions in school.

147 Training in scientific reasoning may also have a long-term impact on student academic achievement
148 (Bao, et al., 2009). Scientific reasoning has an important role in the problem-solving process (Khan and
149 Ullah,2010). When students have high problem-solving skills, it can have an impact on achieving more
150 effective student learning outcomes (Nieminem et al., 2012; Stephens and Clemen, 2010). Low scientific
151 reasoning ability makes learning outcomes low, so media, learning and teaching model, and learning
152 materials are needed to improve student learning outcomes. This is supported by the results of the
153 study (Wati, et al., 2018; Erika, et al., 2018; Jatmiko et al., 2018; Limatahu, et al., 2018; Prahani, et al,
154 2016; Prahani, et al., 2018; Purwaningsih et al., 2018; Sunarti, et al., 2018; Suyidno et al., 2018) that the
155 media, learning and teaching model that is qualified will be able to improve and achieve the learning
156 outcomes.

157 **Conclusions:** Scientific reasoning abilities among eighth-grade junior high school students are still at a
158 low level. It is, therefore, necessary to improve students' scientific reasoning.

159 **References:**

- 160 Afrassa, T. M. (2005). Monitoring mathematics achievement over time. In *Applied Rasch Measurement:*
161 *A Book of Exemplars* (pp. 61-77). Springer, Dordrecht.
- 162 Avery, L. M., Russell, D. J., Raina, P. S., Walter, S. D., & Rosenbaum, P. L. (2003). Rasch analysis of the
163 gross motor function measure: validating the assumptions of the Rasch model to create an interval-level
164 Measure1. *Archives of Physical Medicine and Rehabilitation, 84*(5), 697-705.
- 165 Bao, L., Cai, T., Koenig, K., Fang, K., Han, J., Wang, J., ... & Wang, Y. (2009). Learning and scientific
166 reasoning. *Science, 323*(5914), 586-587.
- 167 Boone, W. J., Townsend, J. S., & Staver, J. (2011). Using Rasch theory to guide the practice of survey
168 development and survey data analysis in science education and to inform science reform efforts: An
169 exemplar utilizing STEBI self-efficacy data. *Science Education, 95*(2), 258-280.
- 170 Chan, S. W., Ismail, Z., & Sumintono, B. (2014). A Rasch model analysis on secondary students'
171 statistical reasoning ability in descriptive statistics. *Procedia-Social and Behavioral Sciences, 129*, 133-
172 139.

- 173 Erika, F., Prahani, B.K., Supardi, Z.A.I., & Tukiran. (2018). The development of metacognition-based
174 learning media for the industrial electronics field in a vocational high school. *World Trans. on Engng. and*
175 *Technol. Educ.*, 16(2), 179-185.
- 176 Iramaneerat, C. H. E. R. D. S. A. K., Smith Jr, E. V., & Smith, R. M. (2008). An introduction to Rasch
177 measurement. *Best practices in quantitative methods*, 50-70.
- 178 Jatmiko, B., Prahani, B.K., Munasir, Supardi, Z.A.I., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R.,
179 and Zainuddin. (2018). The comparison of OR-IPA teaching model and problem based learning model
180 effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science*
181 *Education*, 17(2), 1-22.
- 182 Khan, W., & Ullah, H. (2010). Scientific Reasoning: A Solution to the Problem of Induction. *International*
183 *Journal of Basic & Applied Sciences*, 10(3), 58-62.
- 184 Kuhn, D., & Franklin, S. (2006). *The second decade: What develops (and how)*. John Wiley & Sons, Inc..
- 185 Limatahu I., Suyatno, Wasis, and Prahani, B.K., The effectiveness of CCDSR learning model to improve
186 skills of creating lesson plan and worksheet science process skills (SPS) for pre-service physics teacher. *J.*
187 *Phys. Conf. Ser.*, 997, 32, 1-7 (2018).
- 188 Prahani, B.K., Limatahu, I., Winata, S.W., Yuanita, L., & Nur, M. (2016). Effectiveness of physics learning
189 material through guided inquiry model to improve student's problem solving skills based on multiple
190 representation. *International Journal of Education and Research*. 4 (12), 231-244.
- 191 Prahani, B.K., Nur, M., Yuanita, L., & Limatahu, I. (2016). Validitas model pembelajaran group science
192 learning: Pembelajaran inovatif di Indonesia [Validity of learning model of group science learning:
193 Innovative learning in Indonesia]. *Vidhya Karya*, 31(1), 72-80.
- 194 Prahani, B.K., Suprpto, N., Suliyanah, Lestari, N.A., Jauhariyah, M.N.R, Admoko, S., and Wahyuni, S.,
195 (2018). The effectiveness of collaborative problem based physics learning (CPBPL) model to improve
196 student's self-confidence on physics learning. *Journal Physics: Conference Series*, 997(08), 1-6.
- 197 Purwaningsih, E., Suyatno, Wasis, and Prahani, B.K. (2018). The effectiveness of comcorels model to
198 improve skills of creating physics lesson plan (CPLP) for pre-service physics teacher. *Journal Physics:*
199 *Conference Series*, 997(22), 1-7.
- 200 Rangkuti, A. N. (2017). TANTANGAN DAN PELUANG PEMBELAJARAN MATEMATIKA. *LOGARITMA: Jurnal*
201 *Ilmu-ilmu Kependidikan dan Sains*, 2(1), 1-13.
- 202 Rizta, A., Zulkardi, Z., & Hartono, Y. (2013). Pengembangan Soal Penalaran Model TIMSS Matematika
203 SMP. *Jurnal Penelitian dan Evaluasi Pendidikan*, 17(2), 230-240.
- 204 Salz, S. (2009). *Take the Test: Sample Questions from OECD's PISA Assessments*. OECD Publishing. 2, rue
205 Andre Pascal, F-75775 Paris Cedex 16, France.
- 206 Siregar, H. (2003). Peranan Fisika Pada Disiplin Ilmu Teknik Kimia. *Sumatera Utara: USU digital library*.
- 207 Stephens, A. L. & Clement, J.J. 2010. Documenting The Use of Expert Scientific Reasoning Processes by
208 High School Physics Students. *Physical Review Special Topics-Physics Education Research*. 6(2),020122:
209 1-15.
- 210 Sumintono, B., & Widhiarso, W. (2014). *Aplikasi model Rasch Untuk penelitian ilmu-ilmu sosial (edisi*
211 *revisi)*. Trim Komunikata Publishing House.
- 212 Sumintono, B., & Widhiarso, W. (2015). *Aplikasi pemodelan rasch pada assessment pendidikan*. Trim
213 Komunikata.
- 214 Sunarti T., Wasis, Madlazim, Suyidno, and Prahani, B.K. (2018). The effectiveness of CPI model to
215 improve positive attitude toward science (PATS) for pre-service physics teacher. *Journal Physics:*
216 *Conference Series*, 997(13), 1-7.
- 217 Suyidno, Nur, M., Yuanita, L., Prahani, B.K., and Jatmiko, B. (2018). Effectiveness of creative
218 responsibility based teaching (CRBT) model on basic physics learning to increase student's scientific
219 creativity and responsibility. *Journal of Baltic Science Education*, 17(1), 136-151.

12
220 Thompson, E. D., Bowling, B. V., & Markle, R. E. (2018). Predicting student success in a major's
221 introductory biology course via logistic regression analysis of scientific reasoning ability and
222 mathematics scores. *Research in Science Education*, 48(1), 151-163.

3
223 Wati, M., Hartini, S., Hikmah, N., & Mahtari, S. (2018, March). Developing physics learning media using
224 3D cartoon. In *Journal of Physics Conference Series* (Vol. 997, No. 1).

9
225 Zhou, S., Han, J., Koenig, K., Raplinger, A., Pi, Y., Li, D., ... & Bao, L. (2016). Assessment of scientific
226 reasoning: The effects of task context, data, and design on student reasoning in control of variables.
227 *Thinking skills and creativity*, 19, 175-187.

228

229 **Declaration of Conflicting Interests**

20
230 We declare that there is no potential conflict of interest with respect to the research,
231 authorship and / or publication of this article.

232 **Funding**

2
233 We did not receive financial support for the research, authorship and / or publication of this
234 article

235 **2**
235 **1. Main headings (Level 1) (Calibri 12)**

236 [Text Body] (Calibri 10)

237

238 **1.1. Second-level headings (Calibri 12)**

239 [Text Body] (Calibri 10)

240

241 Third-level headings (Calibri 12)

242 [Text Body] (Calibri 10)

243

244 Table:

bold italic, 10 pt	bold italic, 10	bold italic, 10	bold italic, 10	bold italic, 10
<i>italic, 10 pt</i>	Normal 10 pt			
<i>italic, 10 pt</i>		10 pt	10 pt	
<i>italic, 10 pt</i>				10 pt

245 Table 1. Information about table 1

246 Figures:



247

248 Figure 1. Legend content

249

250

251

252

253

2

254 **Declaration of Conflicting Interests**

255 The author(s) declared no potential conflicts of interest with respect to the research,
256 authorship, and/or publication of this article.

257 Note: if there is some conflicting interest, please detail it.

258

259 **Funding**

260 The author(s) received no financial support for the research, authorship, and/or publication of
261 this article.

262 Note: if the author(s) received financial support, please detail it.

263

264 **References**

265 Please write cites in text using the last edition of APA style. Here, you can find the most important rules;
266 however, you can find the complete rules in the American Psychological Association
267 (<http://www.apa.org/>).

268

ORIGINALITY REPORT

29%

SIMILARITY INDEX

26%

INTERNET SOURCES

17%

PUBLICATIONS

19%

STUDENT PAPERS

PRIMARY SOURCES

1

umexpert.um.edu.my

Internet Source

5%

2

www.jotse.org

Internet Source

4%

3

journal.unesa.ac.id

Internet Source

3%

4

Submitted to University Tun Hussein Onn
Malaysia

Student Paper

2%

5

eprints.unm.ac.id

Internet Source

1%

6

libir1.ied.edu.hk

Internet Source

1%

7

oaji.net

Internet Source

1%

8

Ohle, Annika, William J. Boone, and Hans E. Fischer. "INVESTIGATING THE IMPACT OF TEACHERS' PHYSICS CK ON STUDENTS OUTCOMES", International Journal of Science

1%

and Mathematics Education, 2014.

Publication

9	www.iacis.org Internet Source	1%
10	Submitted to Mont Rose College Student Paper	1%
11	Submitted to University of Houston System Student Paper	1%
12	Submitted to Pascasarjana Universitas Negeri Malang Student Paper	1%
13	www.researchgate.net Internet Source	1%
14	www.science.gov Internet Source	1%
15	eprints.um.edu.my Internet Source	1%
16	Submitted to Universitas Negeri Jakarta Student Paper	1%
17	Submitted to University College London Student Paper	1%
18	journal.unnes.ac.id Internet Source	1%

e-journal.ikip-veteran.ac.id

19

Internet Source

1%

20

journals.sagepub.com

Internet Source

1%

21

Submitted to Universitas Siswa Bangsa
Internasional

Student Paper

Exclude quotes Off

Exclude matches < 1%

Exclude bibliography On

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

/0

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

**2. Bukti konfirmasi
submission dari iJIM
via e-mail
(7 May 2019)**

[iJIM] A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability 📄 📄
External Inbox x

 **Michael E. Auer** auer@cti-online.net via lib-ojs5.lib.sfu.ca Tue, May 7, 2019, 5:04 AM ☆ ↶ ⋮
to Saiyidah, me, Sri, Heny ▾

Dear authors,

I am currently identifying and contacting reviewers who are acknowledged experts in the field. Since peer review is a voluntary service it can take time to find reviewers who are both qualified and available. When I have received the required number of expert reviews, I evaluate the reviews before making a decision on your manuscript.

Kind regards,

[ijim](http://www.i-jim.org)

International Journal of Interactive Mobile Technologies
<http://www.i-jim.org>

↶ Reply ↶ Reply all ↷ Forward

**3. Bukti status
'in review' pada OJS
(8 May 2019)**

← → ↻ 🏠 <https://online-journals.org/index.php/i-jim/author> ⋮ 🌐 ⚙️ 📄 📧 📧 📧 📧 📧

iJIM International Journal of Interactive Mobile Technologies

HOME ABOUT USER HOME SEARCH CURRENT ARCHIVES ANNOUNCEMENTS

Home > User > Author > Active Submissions

Active Submissions

ACTIVE ARCHIVE

ID	MM-DD SUBMIT	SEC	AUTHORS	TITLE	STATUS
10760	04-29	SHO	Mahtani, Wati, Hartini, Amelia	A RASCH MODEL ANALYSIS ON JUNIOR HIGH SCHOOL STUDENTS...	IN REVIEW

1 - 1 of 1 Items

Start a New Submission
[CLICK HERE](#) to go to step one of the five-step submission process.

International Journal of Interactive Mobile Technologies (IJIM) - eISSN: 1865-7923
Indexing:

Scopus[®] IET Inspec dblp EBSCO ULRICHSWEB[®] Academic Search

CC BY

Font Size: [A](#) [A](#) [A](#)

USER
You are logged in as...
saiyidah
• [My Journals](#)
• [My Profile](#)
• [Log Out](#)

AUTHOR
Submissions
• [Active \(1\)](#)
• [Archive \(0\)](#)
• [New Submission](#)

JOURNAL CONTENT
Search:
Search Scope:
All

Learn How to Speed It Up Don't Tell Me Again

Mozilla Firefox seems slow... to... start.

10:46 AM
5/8/2019

**4. Resubmitted after
review melalui OJS
(4 Juni 2019)**

A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability

<https://doi.org/10.3991/ijxx.vx.ix.xxxx>

Mustika Wati, Saiyidah Mahtari, Sri Hartini, Heny Amalia
Physics Education Study Program
FKIP Universitas Lambung Mangkurat
Indonesia
mustika_pfis@ulm.ac.id, saiyidah_pfis@ulm.ac.id,
srihartini_pfis@ulm.ac.id

Abstract—Science education that emphasizes only the count is not relevant at the moment. Students must make scientific reasoning in answering the problem. This study aims to determine students' scientific reasoning abilities in light matter. The method in this research was the descriptive method by using the survey technique. The instrument used is a description test consisting of 8 items of light matter. This test was conducted on 201 students from the eighth-grade junior high school in Banjarmasin selected at random. The RASCH model is used as a processing stage of data from raw data into logit numbers that provide information related to infit, outfit and unidimensionality using a winstep program to achieve this goal, this study investigated the quality of items from Item and person measure, Item Bias, item and person reliability, and variable map. The findings show that the scientific reasoning ability of the eighth-grade students can be at a low level. So researchers should strive to improve students' scientific reasoning abilities in future research. □

Keywords – Rasch Model, Construct Validity, Test, Scientific Reasoning

1 Introduction

Physics can be interpreted as a science of measurement because everything we know about the world of physics and the principles governing its behaviour has been studied through observations of natural phenomena. Physics is a science that requires more understanding than shipping (Siregar, 2003). The purpose of learning physics is the formation of reasoning ability in students reflected through the ability to think logically, critically, and systematically in problems solving, especially in the field of physics (Rangkuti, 2015). In the Curriculum 2013, it is explained that one of the core competencies in learning, especially for grades VIII and IX SMP is to cultivate, decorate, and reason in the realm of concrete and abstract realms as studied in schools and other sources in the same point of view/theory.

Scientific reasoning is one of the 21st-century skills that is expected to be taught in the science classroom in an effort to prepare students for their success in facing the challenges of globalization. Scientific reasoning is highly emphasized in new science education standards (Zhou, et al., 2016). In the PISA test, the skill is also one of the skills tested (Salz, 2009). The scientific reasoning could be an effective predictor of student success and thus could potentially be used in practical decision making for the course (Thompson, et al., 2018). Students who are used to solve problems indirectly develop the thought process of reasoning (Rizta et al., 2013). In a series of studies, they showed that the scientific reasoning of preadolescent children was severely deficient (Kuhn & Franklin, 2006).

Georg Rasch developed an analytical model of the response theory of grains (or Item Response Theory, IRT) in the 1960s (Boone et al., 2011). IRT is an alternative test measurement theory in addition to Classical test theory. Classical tests of these theories enable the presumption of test results such as the difficulty of items and the ability of people. IRT focuses on the pattern of responses given by the person to the test item and background person. IRT has many advantages and is more complex than the Classical test theory (Chan et al., 2013). Rasch measurement model or one parameter model is the simplest IRT model, and it has strong measurement properties (Afrassa, 2005). Raw data in the form of dichotomous data (in the form of right and wrong) that indicate students' abilities, Rasch formulates this into a model that connects students and item (Sumintono and Widhiarso, 2014). The benefit of Rasch's analysis is its ability to estimate the total score for clients even when not all items have been managed. This is especially useful when working with children who may not adhere to all the constraints of standard testing situations (Avery et al., 2003). □

Scientific reasoning is very important for students. It is related to the role of scientific reasoning in the process of solving problems in physics. Thus, this study was conducted to describe the students' scientific reasoning abilities using the Rasch measurement model □

2 Methodology

The method in this research was the descriptive method by using the survey technique. In this study, the participant was 201 eighth grade students from 3 junior high schools in Banjarmasin. They were chosen at random. Their age was between 14-15 years old. The study was conducted in April 2017. All participants had studied light material before the test. The instrument used in this study is a scientific reasoning test on light material with eight questions. The purpose of this test was to test students' scientific reasoning abilities. Students are given time to answer the test for eighty minutes. The test results are then used as data in this study. Each student is labelled with codes A, B and C for the representation of the origin of the school. The description described students' reasoning abilities gained after students completed the reasoning ability of reasoning instruments on the Light material. The result data will be included in the winstep software which is one of the series in the Rasch model

with the data polytomy. Output in this software that is in the form of the Item Measure table, Person Measure, Variable Maps and Reliability which have been converted before becoming a logit number. This logit number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling.

Output winstep is in the form of Item Measure table, Person Measure, Variable Maps and Reliability which have been converted before becoming logit number. This logit number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling. The parameters used are infit and outfit of the mean square and standardized values. According to Sumintono and Widhiarso (2014), infit (inlier sensitive or information weighted fit) is the sensitivity of response pattern to target item on respondent (person) or vice versa; while outfit (outlier sensitive fit) measures the sensitivity of the response pattern to the item with a certain degree of difficulty on the respondent or vice versa. According to Sumintono and Widhiarso (2015) of the logit numbers obtained from the Ministep software output, there is an interval scale (logit rule) which describes the state of the number. The scale is:

1. The value of Mean Square Outfit (MNSQ) received: $0.5 < \text{MNSQ} < 1.5$
2. The accepted Z-Standard Output (ZSTD) value: $-2.0 < \text{ZSTD} < +2.0$
3. Point Measure Correlation Value (Pt Mean Corr): $0.4 < \text{Pt Measure Corr} < 0.85$

Therefore, the respondent would be qualified based on the value relating to the entry and absence of respondents in the modelling. Reliability questions with Rasch modelling were analyzed using individual separation values and grain separations as well as Cronbach Alpha values displayed in Rasch program outputs. The higher the value of individual separation and the value of the grain separation and the Alpha Cronbach value the better the reliability of the problem. The criteria for interpreting the value of individual separation and the separation of an instrument's grain can be seen using Table 1 (Sumintono and Widhiarso, 2015).

Table 1. Interpretation of individual separation values and Instrument separation items

Criteria	Value of separation individual and item
Weak	<0,67
Enough	0,67-0,80
Nice	0,81-0,90
Very Good	0,91-0,94
Special	>0,94

The Cronbach Alpha values used to measure interactions between individuals with whole grains can be interpreted using Table 2 (Sumintono and Widhiarso, 2015).

Table 2 Interpretation of Cronbach Alpha values

Criteria	Alpha Cronbach
Bad	< 0,5
Ugly	0,5 – 0,6
Enough	0,6 – 0,7
Nice	0,7 – 0,8
Very Good	>0,8

Problem level of difficulty with Rasch modelling is analyzed by using logit number contained in the measurement column problem, the higher the logit value than the higher the difficulty level of the problem. In the measurement of the problem, there is also information on the standard deviation value. If the value is combined with an average logit score, the difficulty level of the items can be grouped according to the difficulty level as in Table 3 (Sumintono and Widhiarso, 2015).

Table 3. Interpretation of Problem Exchange Index

Interpretation	Criteria
Difficult	0,00 logit + 1SD
Very Difficult	>+ 1SD
Easy	0,00 logit – 1SD
Very Easy	<- 1SD

3 Result and Discussion

Table 4. Results summary of the winstep program output

Item number	Infit		Outfit		PT-Measure		Prob	Measure
	MNSQ	ZSTD	MNSQ	ZSTD	CORR	EXP		
1	1.15	1.5	1.15	0.8	0.59	0.64	0.4915	-0.81
2	1.03	0.3	0.92	-0.6	0.68	0.67	0.0001	-0.26
3	0.79	-2.0	0.81	-1.7	0.69	0.65	0.2022	0.13
4	1.05	0.5	1.22	1.5	0.55	0.6	0.5853	-0.20
5	0.61	-2.8	0.6	-2.7	0.77	0.7	0.2197	0.64
6	0.5	-4.1	0.52	-3.7	0.81	0.71	0.4565	0.63
7	1.38	2.7	1.47	2.7	0.49	0.58	0.0031	-0.14
8	1.18	1.3	1.29	1.6	0.6	0.63	0.0111	0.01
S.D								0.45
Person Reliability 0.79								
Item Reliability 0.99								
Cronbach Alpha 0.85								

measurements were items 2, 7 and 8. This indicates that these three items need to be improved so as not to harm a particular school.

Reliability problems developed for the criteria of person reliability into the category was nice, the criteria of the reliability of the item entered into the category special, and Cronbach Alpha criteria into the category of very good. Thus, overall these questions can be trusted to measure students' reasoning abilities. It also shows that the reliability of the items was very good. In Table 4, it can be seen in the Item Number column that item 5 was the hardest problem with a logit value of 0.64 and question number 1 was the easiest problem with a logit value of -0.81, it corresponds to the cognitive domain of the reasoning problem developed. Items 5, 6, and 3 had Cognitive domains C5, items 8, 7, and 4 had C4 cognitive domains, and item 1 has C3 cognitive domains. Item 2 had Cognitive domain C5, but it was not by the results of research analysis that shows the problem is entered in the category very easily with a logit value of -0.26. It was also shown by the number of students who can correctly answer the question. □

The variable map shows the distribution of student ability and item difficulty on the same logit scale. Students' abilities are listed on the left side of the map while the item difficulty is on the right side of the map. The higher logit represents students with higher abilities (the left side) and more difficult items (right side) and vice versa (Iramaneerat, Smith, and Smith, 2008). Through the variable map, it allows us to identify whether the item matches the student's abilities. The relation of ability possessed by students with problem level in figure 1, on the left side shows the distribution of students' reasoning ability and the right side shows the difficulty level of the item. The left side of the map shows the higher level of the reasoning problem. This means the student could get the maximum value of all questions.

On the right side of the map are eight items that have difficulty levels that from item 5 was the most difficult to item 1 the easiest to do. This means that there is no problem that accumulates in one line only, it shows the problem of having various levels of difficulty, ranging from the most difficult to the easiest. Logit 0 is set as the average test item (Iramaneerat, Smith, and Smith, 2008). From the variable map, we can see that most students are below the average of the exam items. Few students with higher abilities are above logit 0 and very many students are below average. Low logit indicates low ability. Thus we can argue that the students' ability in scientific reasoning is low, as most of them cannot solve the problem of scientific reasoning. In other words, items are deemed less able to fit the student's abilities. This is because students are not familiar with the scientific reasoning items in this study and they are not taught to answer these kinds of questions in school.

Training in scientific reasoning may also have a long-term impact on student academic achievement (Bao, et al., 2009). Scientific reasoning has an important role in the problem-solving process (Khan and Ullah, 2010). When students have high problem-solving skills, it can have an impact on achieving more effective student learning outcomes (Nieminem et al., 2012; Stephens and Clemen, 2010). Low scientific reasoning ability makes learning outcomes low, so media, learning and teaching model, and learning materials are needed to improve student learning outcomes. This is supported by the results of the study (Wati, et al., 2018; Erika, et

al., 2018; Jatmiko et al., 2018; Limatahu, et al., 2018; Prahani, et al, 2016; Prahani, et al., 2018; Sunarti, et al., 2018; Suyidno et al., 2018) that the media, learning and teaching model that is qualified will be able to improve and achieve the learning outcomes.

4 Conclusions

Scientific reasoning abilities among eighth-grade junior high school students are still at a low level. It is, therefore, necessary to improve students' scientific reasoning.

5 References

- Afrassa, T. M. (2005). Monitoring mathematics achievement over time. In *Applied Rasch Measurement: A Book of Exemplars* (pp. 61-77). Springer, Dordrecht.
- Avery, L. M., Russell, D. J., Raina, P. S., Walter, S. D., & Rosenbaum, P. L. (2003). Rasch analysis of the gross motor function measure: validating the assumptions of the Rasch model to create an interval-level Measure1. *Archives of Physical Medicine and Rehabilitation*, 84(5), 697-705.
- Bao, L., Cai, T., Koenig, K., Fang, K., Han, J., Wang, J., ... & Wang, Y. (2009). Learning and scientific reasoning. *Science*, 323(5914), 586-587.
- Boone, W. J., Townsend, J. S., & Staver, J. (2011). Using Rasch theory to guide the practice of survey development and survey data analysis in science education and to inform science reform efforts: An exemplar utilizing STEBI self-efficacy data. *Science Education*, 95(2), 258-280.
- Chan, S. W., Ismail, Z., & Sumintono, B. (2014). A Rasch model analysis on secondary students' statistical reasoning ability in descriptive statistics. *Procedia-Social and Behavioral Sciences*, 129, 133-139.
- Erika, F., Prahani, B.K., Supardi, Z.A.I., & Tukiran. (2018). The development of metacognition-based learning media for the industrial electronics field in a vocational high school. *World Trans. on Engng. and Technol. Educ.*, 16(2), 179-185.
- Iramaneerat, C. H. E. R. D. S. A. K., Smith Jr, E. V., & Smith, R. M. (2008). An introduction to Rasch measurement. *Best practices in quantitative methods*, 50-70.
- Jatmiko, B., Prahani, B.K., Munasir, Supardi, Z.A.I., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R., and Zainuddin. (2018). The comparison of OR-IPA teaching model and problem based learning model effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science Education*, 17(2), 1-22.
- Khan, W., & Ullah, H. (2010). Scientific Reasoning: A Solution to the Problem of Induction. *International Journal of Basic & Applied Sciences*, 10(3), 58-62.
- Kuhn, D., & Franklin, S. (2006). *The second decade: What develops (and how)*. John Wiley & Sons, Inc..
- Limatahu I., Suyatno, Wasis, and Prahani, B.K., The effectiveness of CCDSR learning model to improve skills of creating lesson plan and worksheet science process skills (SPS) for pre-service physics teacher. *J. Phys. Conf. Ser.*, 997, 32, 1-7 (2018).
- Prahani, B.K., Limatahu, I., Winata, S.W., Yuanita, L., & Nur, M. (2016). Effectiveness of physics learning material through guided inquiry model to improve student's problem solving skills based on multiple representation. *International Journal of Education and Research*. 4 (12), 231-244.
- Prahani, B.K., Nur, M., Yuanita, L., & Limatahu, I. (2016). Validitas model pembelajaran group science learning: Pembelajaran inovatif di Indonesia [Validity of learning model

- of group science learning: Innovative learning in Indonesia]. *Vidhya Karya*, 31(1), 72-80.
- Prahani, B.K., Suprpto, N., Suliyannah, Lestari, N.A., Jauharyah, M.N.R, Admoko, S., and Wahyuni, S., (2018). The effectiveness of collaborative problem based physics learning (CPBPL) model to improve student's self-confidence on physics learning. *Journal Physics: Conference Series*, 997(08), 1-6.
- Rangkuti, A. N. (2017). TANTANGAN DAN PELUANG PEMBELAJARAN MATEMATIKA. *LOGARITMA: Jurnal Ilmu-ilmu Kependidikan dan Sains*, 2(1), 1-13.
- Rizta, A., Zulkardi, Z., & Hartono, Y. (2013). Pengembangan Soal Penalaran Model TIMSS Matematika SMP. *Jurnal Penelitian dan Evaluasi Pendidikan*, 17(2), 230-240.
- Salz, S. (2009). *Take the Test: Sample Questions from OECD's PISA Assessments*. OECD Publishing, 2, rue Andre Pascal, F-75775 Paris Cedex 16, France.
- Siregar, H. (2003). Peranan Fisika Pada Disiplin Ilmu Teknik Kimia. *Sumatera Utara: USU digital library*.
- Stephens, A. L. & Clement, J.J. 2010. Documenting The Use of Expert Scientific Reasoning Processes by High School Physics Students. *Physical Review Special Topics-Physics Education Research*. 6(2),020122: 1-15
- Sumintono, B., & Widhiarso, W. (2014). *Aplikasi model Rasch Untuk penelitian ilmu-ilmu sosial (edisi revisi)*. Trim Komunikata Publishing House.
- Sumintono, B., & Widhiarso, W. (2015). *Aplikasi pemodelan rasch pada assessment pendidikan*. Trim Komunikata.
- Sunarti T., Wasis, Madlazim, Suyidno, and Prahani, B.K. (2018). The effectiveness of CPI model to improve positive attitude toward science (PATS) for pre-service physics teacher. *Journal Physics: Conference Series*, 997(13), 1-7.
- Suyidno, Nur, M., Yuanita, L., Prahani, B.K., and Jatmiko, B. (2018). Effectiveness of creative responsibility based teaching (CRBT) model on basic physics learning to increase student's scientific creativity and responsibility. *Journal of Baltic Science Education*, 17(1), 136-151.
- Thompson, E. D., Bowling, B. V., & Markle, R. E. (2018). Predicting student success in a major's introductory biology course via logistic regression analysis of scientific reasoning ability and mathematics scores. *Research in Science Education*, 48(1), 151-163.
- Wati, M., Hartini, S., Hikmah, N., & Mahtari, S. (2018, March). Developing physics learning media using 3D cartoon. In *Journal of Physics Conference Series* (Vol. 997, No. 1).
- Zhou, S., Han, J., Koenig, K., Raplinger, A., Pi, Y., Li, D., ... & Bao, L. (2016). Assessment of scientific reasoning: The effects of task context, data, and design on student reasoning in control of variables. *Thinking skills and creativity*, 19, 175-187.

6 Authors

Mustika Wati is a senior lecturer at Physics Education Study Program. She holds a doctors degree in education research and evaluation. She is a research area of focus is physics education. □

Saiyidah Mahtari is a lecture at Physics Education Study Program, FKIP Universitas Lambung Mangkurat. She holds a masters degree in Science Education. She is a research area of focus is physics education. □

Sri Hartini is a senior lecturer at Physics Education Study Program. She holds a masters degree in Physics. She is a research area of focus is physics education. □

Heny Amalia is a college student at Physics Education Study Program.

Article submitted 29 April 2019. Resubmitted 04 Juni 2019. Final acceptance Final version published as resubmitted by the authors

Journal of Technology and Science
Education

5. Final acceptance
(mention in the article
by iJIM)
(7 Juni 2019)

A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability

<https://doi.org/10.3991/ijim.v13i07.10760>

Mustika Wati, Saiyidah Mahtari (✉), Sri Hartini, Heny Amalia
FKIP Universitas Lambung Mangkurat, Indonesia
saiyidah_pfis@ulm.ac.id

Abstract—Science education that emphasizes only the count is not relevant at the moment. Students must make scientific reasoning in answering the problem. This study aims to determine students' scientific reasoning abilities in light matter. The method in this research was the descriptive method by using the survey technique. The instrument used is a description test consisting of 8 items of light matter. This test was conducted on 201 students from the eighth-grade junior high school in Banjarmasin selected at random. The RASCH model is used as a processing stage of data from raw data into logit numbers that provide information related to infit, outfit and unidimensionality using a winstep program to achieve this goal, this study investigated the quality of items from Item and person measure, Item Bias, item and person reliability, and variable map. The findings show that the scientific reasoning ability of the eighth-grade students can be at a low level. So researchers should strive to improve students' scientific reasoning abilities in future research.

Keywords—Rasch Model, Construct Validity, Test, Scientific Reasoning

1 Introduction

Physics can be interpreted as a science of measurement because everything we know about the world of physics and the principles governing its behaviour has been studied through observations of natural phenomena. Physics is a science that requires more understanding than shipping (Siregar, 2003). The purpose of learning physics is the formation of reasoning ability in students reflected through the ability to think logically, critically, and systematically in problems solving, especially in the field of physics (Rangkuti, 2015). In the Curriculum 2013, it is explained that one of the core competencies in learning, especially for grades VIII and IX SMP is to cultivate, decorate, and reason in the realm of concrete and abstract realms as studied in schools and other sources in the same point of view/theory.

Scientific reasoning is one of the 21st-century skills that is expected to be taught in the science classroom in an effort to prepare students for their success in facing the challenges of globalization. Scientific reasoning is highly emphasized in new science education standards (Zhou, et al., 2016). In the PISA test, the skill is also one of the skills tested (Salz, 2009). The scientific reasoning could be an effective predictor of

student success and thus could potentially be used in practical decision making for the course (Thompson, et al., 2018). Students who are used to solve problems indirectly develop the thought process of reasoning (Rizta et al., 2013). In a series of studies, they showed that the scientific reasoning of preadolescent children was severely deficient (Kuhn & Franklin, 2006).

Georg Rasch developed an analytical model of the response theory of grains (or Item Response Theory, IRT) in the 1960s (Boone et al., 2011). IRT is an alternative test measurement theory in addition to Classical test theory. Classical tests of these theories enable the presumption of test results such as the difficulty of items and the ability of people. IRT focuses on the pattern of responses given by the person to the test item and background person. IRT has many advantages and is more complex than the Classical test theory (Chan et al., 2013). Rasch measurement model or one parameter model is the simplest IRT model, and it has strong measurement properties (Afrassa, 2005). Raw data in the form of dichotomous data (in the form of right and wrong) that indicate students' abilities, Rasch formulates this into a model that connects students and item (Sumintono and Widhiarso, 2014). The benefit of Rasch's analysis is its ability to estimate the total score for clients even when not all items have been managed. This is especially useful when working with children who may not adhere to all the constraints of standard testing situations (Avery et al., 2003).

Scientific reasoning is very important for students. It is related to the role of scientific reasoning in the process of solving problems in physics. Thus, this study was conducted to describe the students' scientific reasoning abilities using the Rasch measurement model.

2 Methodology

The method in this research was the descriptive method by using the survey technique. In this study, the participant was 201 eighth grade students from 3 junior high schools in Banjarmasin. They were chosen at random. Their age was between 14-15 years old. The study was conducted in April 2017. All participants had studied light material before the test. The instrument used in this study is a scientific reasoning test on light material with eight questions. The purpose of this test was to test students' scientific reasoning abilities. Students are given time to answer the test for eighty minutes. The test results are then used as data in this study. Each student is labelled with codes A, B and C for the representation of the origin of the school. The description described students' reasoning abilities gained after students completed the reasoning ability of reasoning instruments on the Light material. The result data will be included in the winstep software which is one of the series in the Rasch model with the data polytomy. Output in this software that is in the form of the Item Measure table, Person Measure, Variable Maps and Reliability which have been converted before becoming a logit number. This logit number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling.

Output winstep is in the form of Item Measure table, Person Measure, Variable Maps and Reliability which have been converted before becoming logit number. This logit number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling. The parameters used are infit and outfit of the mean square and standardized values. According to Sumintono and Widhiarso (2014), infit (inlier sensitive or information weighted fit) is the sensitivity of response pattern to target item on respondent (person) or vice versa; while outfit (outlier sensitive fit) measures the sensitivity of the response pattern to the item with a certain degree of difficulty on the respondent or vice versa. According to Sumintono and Widhiarso (2015) of the logit numbers obtained from the Ministep software output, there is an interval scale (logit rule) which describes the state of the number. The scale is:

- The value of Mean Square Outfit (MNSQ) received: $0.5 < \text{MNSQ} < 1.5$
- The accepted Z-Standard Output (ZSTD) value: $-2.0 < \text{ZSTD} < +2.0$
- Point Measure Correlation Value (Pt Mean Corr): $0.4 < \text{Pt Measure Corr} < 0.85$

Therefore, the respondent would be qualified based on the value relating to the entry and absence of respondents in the modelling. Reliability questions with Rasch modelling were analyzed using individual separation values and grain separations as well as Cronbach Alpha values displayed in Rasch program outputs. The higher the value of individual separation and the value of the grain separation and the Alpha Cronbach value the better the reliability of the problem. The criteria for interpreting the value of individual separation and the separation of an instrument's grain can be seen using Table 1 (Sumintono and Widhiarso, 2015).

Table 1. Interpretation of individual separation values and Instrument separation items

Criteria	Value of separation individual and item
Weak	<0,67
Enough	0,67-0,80
Nice	0,81-0,90
Very Good	0,91-0,94
Special	>0,94

The Cronbach Alpha values used to measure interactions between individuals with whole grains can be interpreted using Table 2 (Sumintono and Widhiarso, 2015).

Table 2. Interpretation of Cronbach Alpha values

Criteria	Alpha Cronbach
Bad	< 0,5
Ugly	0,5 – 0,6
Enough	0,6 – 0,7
Nice	0,7 – 0,8
Very Good	>0,8

Problem level of difficulty with Rasch modelling is analyzed by using logit number contained in the measurement column problem, the higher the logit value than the higher the difficulty level of the problem. In the measurement of the problem, there is also information on the standard deviation value. If the value is combined with an average logit score, the difficulty level of the items can be grouped according to the difficulty level as in Table 3 (Sumintono and Widhiarso, 2015).

Table 3. Interpretation of Problem Exchange Index

Interpretation	Criteria
Difficult	0,00 logit + 1SD
Very Difficult	>+ 1SD
Easy	0,00 logit – 1SD
Very Easy	<- 1SD

3 Result and Discussion

Table 4. Results summary of the winstep program output

Item number	Infit		Outfit		PT-Measure		Prob	Measure
	<i>MNSQ</i>	<i>ZSTD</i>	<i>MNSQ</i>	<i>ZSTD</i>	<i>CORR</i>	<i>EXP</i>		
1	1.15	1.5	1.15	0.8	0.59	0.64	0.4915	-0.81
2	1.03	0.3	0.92	-0.6	0.68	0.67	0.0001	-0.26
3	0.79	-2.0	0.81	-1.7	0.69	0.65	0.2022	0.13
4	1.05	0.5	1.22	1.5	0.55	0.6	0.5853	-0.20
5	0.61	-2.8	0.6	-2.7	0.77	0.7	0.2197	0.64
6	0.5	-4.1	0.52	-3.7	0.81	0.71	0.4565	0.63
7	1.38	2.7	1.47	2.7	0.49	0.58	0.0031	-0.14
8	1.18	1.3	1.29	1.6	0.6	0.63	0.0111	0.01
S.D								0.45

Person Reliability 0.79
 Item Reliability 0.99
 Cronbach Alpha 0.85

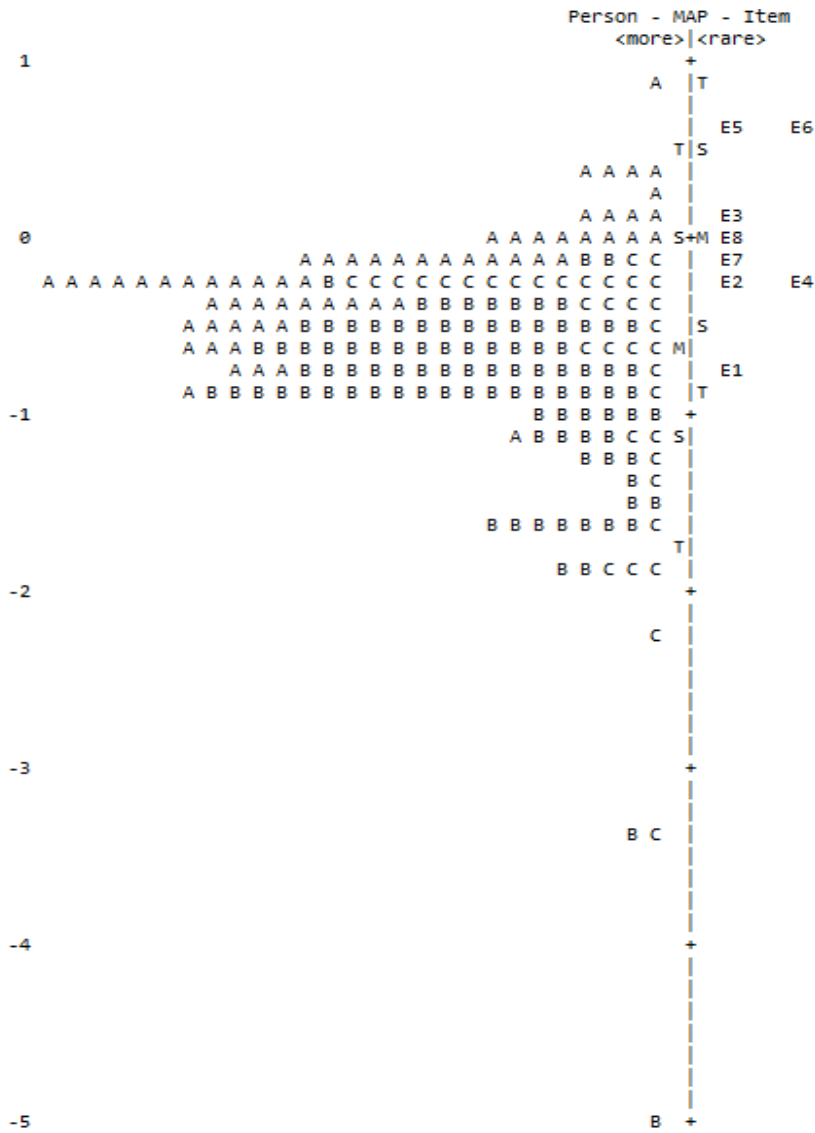


Fig. 1. Variable map

Based on Table 4, it can be seen that the top item is item 7 has a tendency that is less fit. When viewed from three criteria, item 7 only does not qualify at ZSTD outfit value that was equal to 2.7 or unpredictable data, but for MNSQ outfit value that was equal to 1.47 still, meet good criteria for measurement. The value of Pt Measure Corr also meets the criteria of 0.49. Therefore, item 7 can be maintained and did not need to be fixed. This is similar to the items 5 and six that have ZSTD values of -2.7 and -3.7 or too small, so data was too predictable but can still be maintained to measure

students' reasoning abilities. As for the items other items have the value of MNSQ, ZSTD, and Pt Measure Corr by the criteria, so it does not need to be repaired. However, according to Sumintono and Widhiarso (2015), the value of the grain conformity consisting of Outfit MNSQ, ZSTD, and Pt Measure Corr is strongly influenced by the size of the sample size.

A point item is called bias if it is found that one individual with a particular characteristic is more favourable than that of an individual with another characteristic (Sumintono and Widhiarso 2015). An item is said to contain bias if it is found that the probability value of the item is below 5%. In Rasch modelling to detect the biased problem can be seen in Table 4. There were three items that are biased, and five items are unbiased. So, there were five items that can be directly used to measure students' reasoning ability and three items that need to be improved to make good measurements were items 2, 7 and 8. This indicates that these three items need to be improved so as not to harm a particular school.

Reliability problems developed for the criteria of person reliability into the category was nice, the criteria of the reliability of the item entered into the category special, and Cronbach Alpha criteria into the category of very good. Thus, overall these questions can be trusted to measure students' reasoning abilities. It also shows that the reliability of the items was very good. In Table 4, it can be seen in the Item Number column that item 5 was the hardest problem with a logit value of 0.64 and question number 1 was the easiest problem with a logit value of -0.81, it corresponds to the cognitive domain of the reasoning problem developed. Items 5, 6, and 3 had Cognitive domains C5, items 8, 7, and 4 had C4 cognitive domains, and item 1 has C3 cognitive domains. Item 2 had Cognitive domain C5, but it was not by the results of research analysis that shows the problem is entered in the category very easily with a logit value of -0.26. It was also shown by the number of students who can correctly answer the question.

The variable map shows the distribution of student ability and item difficulty on the same logit scale. Students' abilities are listed on the left side of the map while the item difficulty is on the right side of the map. The higher logit represents students with higher abilities (the left side) and more difficult items (right side) and vice versa (Iramaneerat, Smith, and Smith, 2008). Through the variable map, it allows us to identify whether the item matches the student's abilities. The relation of ability possessed by students with problem level in figure 1, on the left side shows the distribution of students' reasoning ability and the right side shows the difficulty level of the item. The left side of the map shows the higher level of the reasoning problem. This means the student could get the maximum value of all questions.

On the right side of the map are eight items that have difficulty levels that from item 5 was the most difficult to item 1 the easiest to do. This means that there is no problem that accumulates in one line only, it shows the problem of having various levels of difficulty, ranging from the most difficult to the easiest. Logit 0 is set as the average test item (Iramaneerat, Smith, and Smith, 2008). From the variable map, we can see that most students are below the average of the exam items. Few students with higher abilities are above logit 0 and very many students are below average. Low logit indicates low ability. Thus we can argue that the students' ability in scientific reason-

ing is low, as most of them cannot solve the problem of scientific reasoning. In other words, items are deemed less able to fit the student's abilities. This is because students are not familiar with the scientific reasoning items in this study and they are not taught to answer these kinds of questions in school.

Training in scientific reasoning may also have a long-term impact on student academic achievement (Bao, et al., 2009). Scientific reasoning has an important role in the problem-solving process (Khan and Ullah, 2010). When students have high problem-solving skills, it can have an impact on achieving more effective student learning outcomes (Nieminem et al., 2012; Stephens and Clemen, 2010). Low scientific reasoning ability makes learning outcomes low, so media, learning and teaching model, and learning materials are needed to improve student learning outcomes. This is supported by the results of the study (Wati, et al., 2018; Erika, et al., 2018; Jatmiko et al., 2018; Limatahu, et al., 2018; Prahani, et al., 2016; Prahani, et al., 2018; Sunarti, et al., 2018; Suyidno et al., 2018) that the media, learning and teaching model that is qualified will be able to improve and achieve the learning outcomes.

4 Conclusions

Scientific reasoning abilities among eighth-grade junior high school students are still at a low level. It is, therefore, necessary to improve students' scientific reasoning.

5 References

- [1] Afrassa, T. M. (2005). Monitoring mathematics achievement over time. In *Applied Rasch Measurement: A Book of Exemplars* (pp. 61-77). Springer, Dordrecht. https://doi.org/10.1007/1-4020-3076-2_4
- [2] Avery, L. M., Russell, D. J., Raina, P. S., Walter, S. D., & Rosenbaum, P. L. (2003). Rasch analysis of the gross motor function measure: validating the assumptions of the Rasch model to create an interval-level Measure1. *Archives of Physical Medicine and Rehabilitation*, 84(5), 697-705. [https://doi.org/10.1016/s0003-9993\(02\)04896-7](https://doi.org/10.1016/s0003-9993(02)04896-7)
- [3] Bao, L., Cai, T., Koenig, K., Fang, K., Han, J., Wang, J., ... & Wang, Y. (2009). Learning and scientific reasoning. *Science*, 323(5914), 586-587.
- [4] Boone, W. J., Townsend, J. S., & Staver, J. (2011). Using Rasch theory to guide the practice of survey development and survey data analysis in science education and to inform science reform efforts: An exemplar utilizing STEBI self-efficacy data. *Science Education*, 95(2), 258-280. <https://doi.org/10.1002/sce.20413>
- [5] Chan, S. W., Ismail, Z., & Sumintono, B. (2014). A Rasch model analysis on secondary students' statistical reasoning ability in descriptive statistics. *Procedia-Social and Behavioral Sciences*, 129, 133-139. <https://doi.org/10.1016/j.sbspro.2014.03.658>
- [6] Erika, F., Prahani, B.K., Supardi, Z.A.I., & Tukiran. (2018). The development of metacognition-based learning media for the industrial electronics field in a vocational high school. *World Trans. on Engng. and Technol. Educ.*, 16(2), 179-185.
- [7] Iramaneerat, C. H. E. R. D. S. A. K., Smith Jr, E. V., & Smith, R. M. (2008). An introduction to Rasch measurement. *Best practices in quantitative methods*, 50-70. <https://doi.org/10.4135/9781412995627.d6>

- [8] Jatmiko, B., Prahani, B.K., Munasir, Supardi, Z.A.I., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R., and Zainuddin. (2018). The comparison of OR-IPA teaching model and problem based learning model effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science Education*, 17(2), 1-22.
- [9] Khan, W., & Ullah, H. (2010). Scientific Reasoning: A Solution to the Problem of Induction. *International Journal of Basic & Applied Sciences*, 10(3), 58-62.
- [10] Kuhn, D., & Franklin, S. (2006). *The second decade: What develops (and how)*. John Wiley & Sons, Inc..
- [11] Limatahu I., Suyatno, Wasis, and Prahani, B.K., The effectiveness of CCDSR learning model to improve skills of creating lesson plan and worksheet science process skills (SPS) for pre-service physics teacher. *J. Phys. Conf. Ser.*, 997, 32, 1-7 (2018). <https://doi.org/10.1088/1742-6596/997/1/012032>
- [12] Prahani, B.K., Limatahu, I., Winata, S.W., Yuanita, L., & Nur, M. (2016). Effectiveness of physics learning material through guided inquiry model to improve student's problem solving skills based on multiple representation. *International Journal of Education and Research*. 4 (12), 231-244.
- [13] Prahani, B.K., Nur, M., Yuanita, L., & Limatahu, I. (2016). Validitas model pembelajaran group science learning: Pembelajaran inovatif di Indonesia [Validity of learning model of group science learning: Innovative learning in Indonesia]. *Vidhya Karya*, 31(1), 72-80. <https://doi.org/10.20527/jvk.v31i1.3976>
- [14] Prahani, B.K., Suprpto, N., Suliyanah, Lestari, N.A., Jauhariyah, M.N.R, Admoko, S., and Wahyuni, S., (2018). The effectiveness of collaborative problem based physics learning (CPBPL) model to improve student's self-confidence on physics learning. *Journal Physics: Conference Series*, 997(08), 1-6. <https://doi.org/10.1088/1742-6596/997/1/012008>
- [15] Rangkuti, A. N. (2017). TANTANGAN DAN PELUANG PEMBELAJARAN MATEMATIKA. *LOGARITMA: Jurnal Ilmu-ilmu Kependidikan dan Sains*, 2(1), 1-13. <https://doi.org/10.24952/logaritma.v5i01.1257>
- [16] Rizta, A., Zulkardi, Z., & Hartono, Y. (2013). Pengembangan Soal Penalaran Model TIMSS Matematika SMP. *Jurnal Penelitian dan Evaluasi Pendidikan*, 17(2), 230-240. <https://doi.org/10.21831/pep.v17i2.1697>
- [17] Salz, S. (2009). *Take the Test: Sample Questions from OECD's PISA Assessments*. OECD Publishing, 2, rue Andre Pascal, F-75775 Paris Cedex 16, France. <https://doi.org/10.1177/0047287594033002101>
- [18] Siregar, H. (2003). Peranan Fisika Pada Disiplin Ilmu Teknik Kimia. *Sumatera Utara: USU digital library*.
- [19] Stephens, A. L. & Clement, J.J. 2010. Documenting The Use of Expert Scientific Reasoning Processes by High School Physics Students. *Physical Review Special Topics-Physics Education Research*. 6(2),020122: 1-15. <https://doi.org/10.1103/physrevstper.6.020122>
- [20] Sumintono, B., & Widhiarso, W. (2014). *Aplikasi model Rasch Untuk penelitian ilmu-ilmu sosial (edisi revisi)*. Trim Komunikata Publishing House.
- [21] Sumintono, B., & Widhiarso, W. (2015). *Aplikasi pemodelan rasch pada assessment pendidikan*. Trim Komunikata.
- [22] Sunarti T., Wasis, Madlazim, Suyidno, and Prahani, B.K. (2018). The effectiveness of CPI model to improve positive attitude toward science (PATS) for pre-service physics teacher. *Journal Physics: Conference Series*, 997(13), 1-7. <https://doi.org/10.1088/1742-6596/997/1/012013>
- [23] Suyidno, Nur, M., Yuanita, L., Prahani, B.K., and Jatmiko, B. (2018). Effectiveness of creative responsibility based teaching (CRBT) model on basic physics learning to increase

- student's scientific creativity and responsibility. *Journal of Baltic Science Education*, 17(1), 136-151. <https://doi.org/10.9790/7388-0701025661>
- [24] Thompson, E. D., Bowling, B. V., & Markle, R. E. (2018). Predicting student success in a major's introductory biology course via logistic regression analysis of scientific reasoning ability and mathematics scores. *Research in Science Education*, 48(1), 151-163. <https://doi.org/10.1007/s11165-016-9563-5>
- [25] Wati, M., Hartini, S., Hikmah, N., & Mahtari, S. (2018, March). Developing physics learning media using 3D cartoon. In *Journal of Physics Conference Series* (Vol. 997, No. 1). <https://doi.org/10.1088/1742-6596/997/1/012044>
- [26] Zhou, S., Han, J., Koenig, K., Raplinger, A., Pi, Y., Li, D., ... & Bao, L. (2016). Assessment of scientific reasoning: The effects of task context, data, and design on student reasoning in control of variables. *Thinking skills and creativity*, 19, 175-187. <https://doi.org/10.1016/j.tsc.2015.11.004>

6 Authors

Mustika Wati is a senior lecturer at Physics Education Study Program. She holds a doctors degree in education research and evaluation. She is a research area of focus is physics education. (mustika_pfis@ulm.ac.id)

Saiyidah Mahtari is a lecture at Physics Education Study Program, FKIP Universitas Lambung Mangkurat. She holds a masters degree in Science Education. She is a research area of focus is physics education.

Sri Hartini is a senior lecturer at Physics Education Study Program. She holds a masters degree in Physics. She is a research area of focus is physics education. (srihartini_pfis@ulm.ac.id)

Heny Amalia is a college student at Physics Education Study Program.

Article submitted 2019-04-29. Resubmitted 2019-06-04. Final acceptance 2019-06-07. Final version published as submitted by the authors.

6. Final version

published

(notes in online version)

(11 Juli 2019)

HOME / ARCHIVES / VOL. 13 NO. 07 (2019) / Short Papers

A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability

Mustika Wati

Universitas Lambung Mangkurat

Saiyidah Mahtari

Universitas Lambung Mangkurat

Sri Hartini

Universitas Lambung Mangkurat

Heny Amelia

Universitas Lambung Mangkurat

DOI: <https://doi.org/10.3991/ijim.v13i07.10760>

Keywords: Rasch Model, Construct Validity, Test, Scientific Reasoning

PDF

PUBLISHED

2019-07-11

HOW TO CITE

Wati, M., Mahtari, S., Hartini, S., & Amelia, H. (2019). A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability. *International Journal of Interactive Mobile Technologies (IJIM)*, 13(07), pp. 141-149. <https://doi.org/10.3991/ijim.v13i07.10760>

RANKINGS

Scopus



OTHER JOURNALS

Your article doesn't fit this journal's scope? Have a look at our other journals: <https://online-journals.org>

Keywords: Rasch Model, Construct Validity, Test, Scientific Reasoning

ABSTRACT

Science education that emphasizes only the count is not relevant at the moment. Students must make scientific reasoning in answering the problem. This study aims to determine students' scientific reasoning abilities in light matter. The method in this research was the descriptive method by using the survey technique. The instrument used is a description test consisting of 8 items of light matter. This test was conducted on 201 students from the eighth-grade junior high school in Banjarmasin selected at random. The RASCH model is used as a processing stage of data from raw data into logit numbers that provide information related to infit, outfit and unidimensionality using a winstep program to achieve this goal, this study investigated the quality of items from Item and person measure, Item Bias, item and person reliability, and variable map. The findings show that the scientific reasoning ability of the eighth-grade students can be at a low level. So researchers should strive to improve students' scientific reasoning abilities in future research.

Students' Scientific Reasoning Ability. *International Journal of Interactive Mobile Technologies (IJIM)*, 13(07), pp. 141-149. <https://doi.org/10.3991/ijim.v13i07.10760>

More Citation Formats

ISSUE

[Vol. 13 No. 07 \(2019\)](#)

SECTION

Short Papers

International Journal of Interactive Mobile Technologies (IJIM) – eISSN: 1865-7923

Indexed in Elsevier Scopus, EI Compindex, EBSCO, dblp, and Scilit. Long-term archiving is assured by Portico. Plagiarism check by iThenticate. Published under CC-BY.

paper bu Mustika

by Paper Bu Mustika

Submission date: 10-Jun-2024 10:43AM (UTC+0700)

Submission ID: 2399263598

File name: 1.pdf (692.07K)

Word count: 3879

Character count: 19807

A Rasch Model Analysis on Junior High School Students' Scientific Reasoning Ability

<https://doi.org/10.3991/ijim.v13i07.10760>

Mustika Wati, Saiyidah Mahtari ^(✉), Sri Hartini, Heny Amalia
FKIP Universitas Lambung Mangkurat, Indonesia
saiyidah_pfis@ulm.ac.id

Abstract—Science education that emphasizes only the count is not relevant at the moment. Students must make scientific reasoning in answering the problem. This study aims to determine students' scientific reasoning abilities in light matter. The method in this research was the descriptive method by using the survey technique. The instrument used is a description test consisting of 8 items of light matter. This test was conducted on 201 students from the eighth-grade junior high school in Banjarmasin selected at random. The RASCH model is used as a processing stage of data from raw data into logit numbers that provide information related to infit, outfit and unidimensionality using a winstep program to achieve this goal, this study investigated the quality of items from Item and person measure, Item Bias, item and person reliability, and variable map. The findings show that the scientific reasoning ability of the eighth-grade students can be at a low level. So researchers should strive to improve students' scientific reasoning abilities in future research.

Keywords—Rasch Model, Construct Validity, Test, Scientific Reasoning

1 Introduction

Physics can be interpreted as a science of measurement because everything we know about the world of physics and the principles governing its behaviour has been studied through observations of natural phenomena. Physics is a science that requires more understanding than shipping (Siregar, 2003). The purpose of learning physics is the formation of reasoning ability in students reflected through the ability to think logically, critically, and systematically in problems solving, especially in the field of physics (Rangkuti, 2015). In the Curriculum 2013, it is explained that one of the core competencies in learning, especially for grades VIII and IX SMP is to cultivate, decorate, and reason in the realm of concrete and abstract realms as studied in schools and other sources in the same point of view/theory.

Scientific reasoning is one of the 21st-century skills that is expected to be taught in the science classroom in an effort to prepare students for their success in facing the challenges of globalization. Scientific reasoning is highly emphasized in new science education standards (Zhou, et al., 2016). In the PISA test, the skill is also one of the skills tested (Salz, 2009). The scientific reasoning could be an effective predictor of

student success and thus could potentially be used in practical decision making for the course (Thompson, et al., 2018). Students who are used to solve problems indirectly develop the thought process of reasoning (Rizta et al., 2013). In a series of studies, they showed that the scientific reasoning of preadolescent children was severely deficient (Kuhn & Franklin, 2006).

Georg Rasch developed an analytical model of the response theory of grains (or Item Response Theory, IRT) in the 1960s (Boone et al., 2011). IRT is an alternative test measurement theory in addition to Classical test theory. Classical tests of these theories enable the presumption of test results such as the difficulty of items and the ability of people. IRT focuses on the pattern of responses given by the person to the test item and background person. IRT has many advantages and is more complex than the Classical test theory (Chan et al., 2013). Rasch measurement model or one parameter model is the simplest IRT model, and it has strong measurement properties (Afrassa, 2005). Raw data in the form of dichotomous data (in the form of right and wrong) that indicate students' abilities, Rasch formulates this into a model that connects students and item (Sumintono and Widhiarso, 2014). The benefit of Rasch's analysis is its ability to estimate the total score for clients even when not all items have been managed. This is especially useful when working with children who may not adhere to all the constraints of standard testing situations (Avery et al., 2003).

Scientific reasoning is very important for students. It is related to the role of scientific reasoning in the process of solving problems in physics. Thus, this study was conducted to describe the students' scientific reasoning abilities using the Rasch measurement model.

2 Methodology

The method in this research was the descriptive method by using the survey technique. In this study, the participant was 201 eighth grade students from 3 junior high schools in Banjarmasin. They were chosen at random. Their age was between 14-15 years old. The study was conducted in April 2017. All participants had studied light material before the test. The instrument used in this study is a scientific reasoning test on light material with eight questions. The purpose of this test was to test students' scientific reasoning abilities. Students are given time to answer the test for eighty minutes. The test results are then used as data in this study. Each student is labelled with codes A, B and C for the representation of the origin of the school. The description described students' reasoning abilities gained after students completed the reasoning ability of reasoning instruments on the Light material. The result data will be included in the winstep software which is one of the series in the Rasch model with the data polytomy. Output in this software that is in the form of the Item Measure table, Person Measure, Variable Maps and Reliability which have been converted before becoming a logit number. This logit number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling.

Output winstep is in the form of Item Measure table, Person Measure, Variable Maps and Reliability which have been converted before becoming logit number. This logit number must qualify the Mean Square Output (MNSQ), Outfit Z-Standard (ZSTD), Point Measure Correlation (Pt Mean Corr) and Reliability values according to Rasch modelling. The parameters used are infit and outfit of the mean square and standardized values. According to Sumintono and Widhiarso (2014), infit (inlier sensitive or information weighted fit) is the sensitivity of response pattern to target item on respondent (person) or vice versa; while outfit (outlier sensitive fit) measures the sensitivity of the response pattern to the item with a certain degree of difficulty on the respondent or vice versa. According to Sumintono and Widhiarso (2015) of the logit numbers obtained from the Ministep software output, there is an interval scale (logit rule) which describes the state of the number. The scale is:

- The value of Mean Square Outfit (MNSQ) received: $0.5 < \text{MNSQ} < 1.5$
- The accepted Z-Standard Output (ZSTD) value: $-2.0 < \text{ZSTD} < +2.0$
- Point Measure Correlation Value (Pt Mean Corr): $0.4 < \text{Pt Measure Corr} < 0.85$

Therefore, the respondent would be qualified based on the value relating to the entry and absence of respondents in the modelling. Reliability questions with Rasch modelling were analyzed using individual separation values and grain separations as well as Cronbach Alpha values displayed in Rasch program outputs. The higher the value of individual separation and the value of the grain separation and the Alpha Cronbach value the better the reliability of the problem. The criteria for interpreting the value of individual separation and the separation of an instrument's grain can be seen using Table 1 (Sumintono and Widhiarso, 2015).

Table 1. Interpretation of individual separation values and Instrument separation items

Criteria	Value of separation individual and item
Weak	<0,67
Enough	0,67-0,80
Nice	0,81-0,90
Very Good	0,91-0,94
Special	>0,94

The Cronbach Alpha values used to measure interactions between individuals with whole grains can be interpreted using Table 2 (Sumintono and Widhiarso, 2015).

Table 2. Interpretation of Cronbach Alpha values

Criteria	Alpha Cronbach
Bad	< 0,5
Ugly	0,5 – 0,6
Enough	0,6 – 0,7
Nice	0,7 – 0,8
Very Good	>0,8

Problem level of difficulty with Rasch modelling is analyzed by using logit number contained in the measurement column problem, the higher the logit value than the higher the difficulty level of the problem. In the measurement of the problem, there is also information on the standard deviation value. If the value is combined with an average logit score, the difficulty level of the items can be grouped according to the difficulty level as in Table 3 (Sumintono and Widhiarso, 2015).

Table 3. Interpretation of Problem Exchange Index

Interpretation	Criteria
Difficult	0,00 logit + 1SD
Very Difficult	>+ 1SD
Easy	0,00 logit – 1SD
Very Easy	<- 1SD

3 Result and Discussion

Table 4. Results summary of the winstep program output

Item number	Infit		Outfit		PT-Measure		Prob	Measure
	MNSQ	ZSTD	MNSQ	ZSTD	CORR	EXP		
1	1.15	1.5	1.15	0.8	0.59	0.64	0.4915	-0.81
2	1.03	0.3	0.92	-0.6	0.68	0.67	0.0001	-0.26
3	0.79	-2.0	0.81	-1.7	0.69	0.65	0.2022	0.13
4	1.05	0.5	1.22	1.5	0.55	0.6	0.5853	-0.20
5	0.61	-2.8	0.6	-2.7	0.77	0.7	0.2197	0.64
6	0.5	-4.1	0.52	-3.7	0.81	0.71	0.4565	0.63
7	1.38	2.7	1.47	2.7	0.49	0.58	0.0031	-0.14
8	1.18	1.3	1.29	1.6	0.6	0.63	0.0111	0.01
S.D								0.45

Person Reliability 0.79
 Item Reliability 0.99
 Cronbach Alpha 0.85

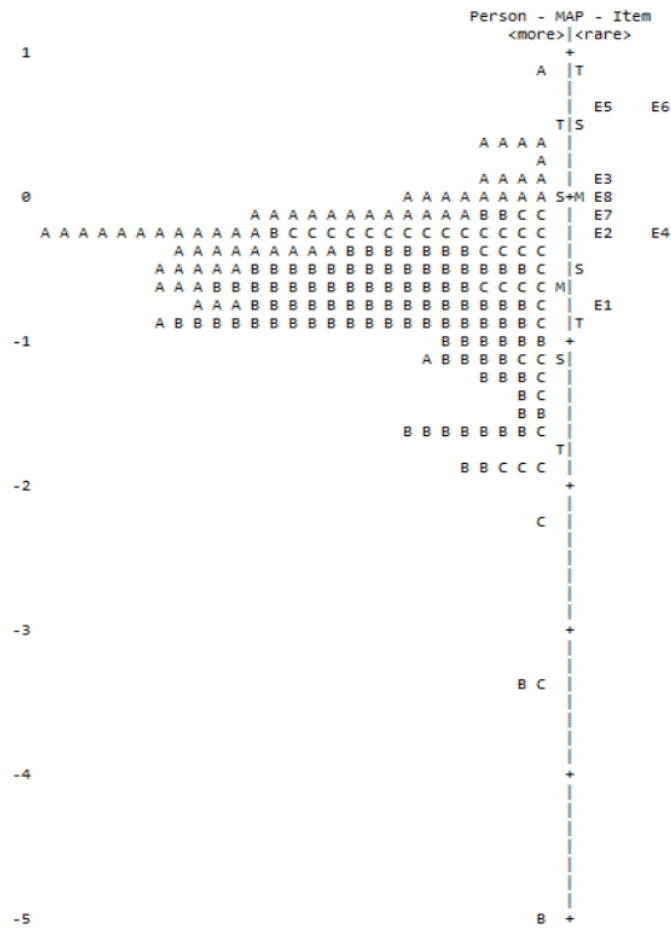


Fig. 1. Variable map

Based on Table 4, it can be seen that the top item is item 7 has a tendency that is less fit. When viewed from three criteria, item 7 only does not qualify at ZSTD outfit value that was equal to 2.7 or unpredictable data, but for MNSQ outfit value that was equal to 1.47 still, meet good criteria for measurement. The value of Pt Measure Corr also meets the criteria of 0.49. Therefore, item 7 can be maintained and did not need to be fixed. This is similar to the items 5 and six that have ZSTD values of -2.7 and -3.7 or too small, so data was too predictable but can still be maintained to measure

students' reasoning abilities. As for the items other items have the value of MNSQ, ZSTD, and Pt Measure Corr by the criteria, so it does not need to be repaired. However, according to Sumintono and Widhiarso (2015), the value of the grain conformity consisting of Outfit MNSQ, ZSTD, and Pt Measure Corr is strongly influenced by the size of the sample size.

A point item is called bias if it is found that one individual with a particular characteristic is more favourable than that of an individual with another characteristic (Sumintono and Widhiarso 2015). An item is said to contain bias if it is found that the probability value of the item is below 5%. In Rasch modelling to detect the biased problem can be seen in Table 4. There were three items that are biased, and five items are unbiased. So, there were five items that can be directly used to measure students' reasoning ability and three items that need to be improved to make good measurements were items 2, 7 and 8. This indicates that these three items need to be improved so as not to harm a particular school.

Reliability problems developed for the criteria of person reliability into the category was nice, the criteria of the reliability of the item entered into the category special, and Cronbach Alpha criteria into the category of very good Thus, overall these questions can be trusted to measure students' reasoning abilities. It also shows that the reliability of the items was very good. In Table 4, it can be seen in the Item Number column that item 5 was the hardest problem with a logit value of 0.64 and question number 1 was the easiest problem with a logit value of -0.81, it corresponds to the cognitive domain of the reasoning problem developed. Items 5, 6, and 3 had Cognitive domains C5, items 8, 7, and 4 had C4 cognitive domains, and item 1 has C3 cognitive domains. Item 2 had Cognitive domain C5, but it was not by the results of research analysis that shows the problem is entered in the category very easily with a logit value of -0.26. It was also shown by the number of students who can correctly answer the question.

The variable map shows the distribution of student ability and item difficulty on the same logit scale. Students' abilities are listed on the left side of the map while the item difficulty is on the right side of the map. The higher logit represents students with higher abilities (the left side) and more difficult items (right side) and vice versa (Iramaneerat, Smith, and Smith, 2008). Through the variable map, it allows us to identify whether the item matches the student's abilities. The relation of ability possessed by students with problem level in figure 1, on the left side shows the distribution of students' reasoning ability and the right side shows the difficulty level of the item. The left side of the map shows the higher level of the reasoning problem. This means the student could get the maximum value of all questions.

On the right side of the map are eight items that have difficulty levels that from item 5 was the most difficult to item 1 the easiest to do. This means that there is no problem that accumulates in one line only, it shows the problem of having various levels of difficulty, ranging from the most difficult to the easiest. Logit 0 is set as the average test item (Iramaneerat, Smith, and Smith, 2008). From the variable map, we can see that most students are below the average of the exam items. Few students with higher abilities are above logit 0 and very many students are below average. Low logit indicates low ability. Thus we can argue that the students' ability in scientific reason-

ing is low, as most of them cannot solve the problem of scientific reasoning. In other words, items are deemed less able to fit the student's abilities. This is because students are not familiar with the scientific reasoning items in this study and they are not taught to answer these kinds of questions in school.

Training in scientific reasoning may also have a long-term impact on student academic achievement (Bao, et al., 2009). Scientific reasoning has an important role in the problem-solving process (Khan and Ullah, 2010). When students have high problem-solving skills, it can have an impact on achieving more effective student learning outcomes (Nieminem et al., 2012; Stephens and Clemen, 2010). Low scientific reasoning ability makes learning outcomes low, so media, learning and teaching model, and learning materials are needed to improve student learning outcomes. This is supported by the results of the study (Wati, et al., 2018; Erika, et al., 2018; Jatmiko et al., 2018; Limatahu, et al., 2018; Prahani, et al., 2016; Prahani, et al., 2018; Sunarti, et al., 2018; Suyidno et al., 2018) that the media, learning and teaching model that is qualified will be able to improve and achieve the learning outcomes.

4 Conclusions

Scientific reasoning abilities among eighth-grade junior high school students are still at a low level. It is, therefore, necessary to improve students' scientific reasoning.

5 References

- [1] Afrassa, T. M. (2005). Monitoring mathematics achievement over time. In *Applied Rasch Measurement: A Book of Exemplars* (pp. 61-77). Springer, Dordrecht. https://doi.org/10.1007/1-4020-3076-2_4
- [2] Avery, L. M., Russell, D. J., Raina, P. S., Walter, S. D., & Rosenbaum, P. L. (2003). Rasch analysis of the gross motor function measure: validating the assumptions of the Rasch model to create an interval-level Measure1. *Archives of Physical Medicine and Rehabilitation*, 84(5), 697-705. [https://doi.org/10.1016/s0003-9993\(02\)04896-7](https://doi.org/10.1016/s0003-9993(02)04896-7)
- [3] Bao, L., Cai, T., Koenig, K., Fang, K., Han, J., Wang, J., ... & Wang, Y. (2009). Learning and scientific reasoning. *Science*, 323(5914), 586-587.
- [4] Boone, W. J., Townsend, J. S., & Staver, J. (2011). Using Rasch theory to guide the practice of survey development and survey data analysis in science education and to inform science reform efforts: An exemplar utilizing STEBI self-efficacy data. *Science Education*, 95(2), 258-280. <https://doi.org/10.1002/sc.20413>
- [5] Chan, S. W., Ismail, Z., & Sumintono, B. (2014). A Rasch model analysis on secondary students' statistical reasoning ability in descriptive statistics. *Procedia-Social and Behavioral Sciences*, 129, 133-139. <https://doi.org/10.1016/j.sbspro.2014.03.658>
- [6] Erika, F., Prahani, B.K., Supardi, Z.A.I., & Tukiran. (2018). The development of metacognition-based learning media for the industrial electronics field in a vocational high school. *World Trans. on Engng. and Technol. Educ.*, 16(2), 179-185.
- [7] Iramaneerat, C. H. E. R. D. S. A. K., Smith Jr, E. V., & Smith, R. M. (2008). An introduction to Rasch measurement. *Best practices in quantitative methods*, 50-70. <https://doi.org/10.4135/9781412995627.d6>

- [8] Jatmiko, B., Prahani, B.K., Munasir, Supardi, Z.A.I., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R., and Zainuddin. (2018). The comparison of OR-IPA teaching model and problem based learning model effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science Education*, 17(2), 1-22.
- [9] Khan, W., & Ullah, H. (2010). Scientific Reasoning: A Solution to the Problem of Induction. *International Journal of Basic & Applied Sciences*, 10(3), 58-62.
- [10] Kuhn, D., & Franklin, S. (2006). *The second decade: What develops (and how)*. John Wiley & Sons, Inc..
- [11] Limatahu I., Suyatno, Wasis, and Prahani, B.K., The effectiveness of CCDSR learning model to improve skills of creating lesson plan and worksheet science process skills (SPS) for pre-service physics teacher. *J. Phys. Conf. Ser.*, 997, 32, 1-7 (2018). <https://doi.org/10.1088/1742-6596/997/1/012032>
- [12] Prahani, B.K., Limatahu, I., Winata, S.W., Yuanita, L., & Nur, M. (2016). Effectiveness of physics learning material through guided inquiry model to improve student's problem solving skills based on multiple representation. *International Journal of Education and Research*. 4 (12), 231-244.
- [13] Prahani, B.K., Nur, M., Yuanita, L., & Limatahu, I. (2016). Validitas model pembelajaran group science learning: Pembelajaran inovatif di Indonesia [Validity of learning model of group science learning: Innovative learning in Indonesia]. *Vidhya Karya*, 31(1), 72-80. <https://doi.org/10.20527/jvk.v3i1.3976>
- [14] Prahani, B.K., Suprpto, N., Suliyannah, Lestari, N.A., Jauhariyah, M.N.R, Admoko, S., and Wahyuni, S., (2018). The effectiveness of collaborative problem based physics learning (CPBPL) model to improve student's self-confidence on physics learning. *Journal Physics: Conference Series*, 997(08), 1-6. <https://doi.org/10.1088/1742-6596/997/1/012008>
- [15] Rangkuti, A. N. (2017). TANTANGAN DAN PELUANG PEMBELAJARAN MATEMATIKA. *LOGARITMA: Jurnal Ilmu-ilmu Kependidikan dan Sains*, 2(1), 1-13. <https://doi.org/10.24952/logaritma.v5i01.1257>
- [16] Rizta, A., Zulkardi, Z., & Hartono, Y. (2013). Pengembangan Soal Penalaran Model TIMSS Matematika SMP. *Jurnal Penelitian dan Evaluasi Pendidikan*, 17(2), 230-240. <https://doi.org/10.21831/pep.v17i2.1697>
- [17] Salz, S. (2009). *Take the Test: Sample Questions from OECD's PISA Assessments*. OECD Publishing. 2, rue Andre Pascal, F-75775 Paris Cedex 16, France. <https://doi.org/10.1177/0047287594033002101>
- [18] Siregar, H. (2003). Peranan Fisika Pada Disiplin Ilmu Teknik Kimia. *Sumatera Utara: USU digital library*.
- [19] Stephens, A. L. & Clement, J.J. 2010. Documenting The Use of Expert Scientific Reasoning Processes by High School Physics Students. *Physical Review Special Topics-Physics Education Research*. 6(2),020122: 1-15. <https://doi.org/10.1103/physrevstper.6.020122>
- [20] Sumintono, B., & Widhiarso, W. (2014). *Aplikasi model Rasch Untuk penelitian ilmu-ilmu sosial (edisi revisi)*. Trim Komunikata Publishing House.
- [21] Sumintono, B., & Widhiarso, W. (2015). *Aplikasi pemodelan rasch pada assessment pendidikan*. Trim Komunikata.
- [22] Sunarti T., Wasis, Madlazim, Suyidno, and Prahani, B.K. (2018). The effectiveness of CPI model to improve positive attitude toward science (PATS) for pre-service physics teacher. *Journal Physics: Conference Series*, 997(13), 1-7. <https://doi.org/10.1088/1742-6596/997/1/012013>
- [23] Suyidno, Nur, M., Yuanita, L., Prahani, B.K., and Jatmiko, B. (2018). Effectiveness of creative responsibility based teaching (CRBT) model on basic physics learning to increase

- student's scientific creativity and responsibility. *Journal of Baltic Science Education*, 17(1), 136-151. <https://doi.org/10.9790/7388-0701025661>
- [24] Thompson, E. D., Bowling, B. V., & Markle, R. E. (2018). Predicting student success in a major's introductory biology course via logistic regression analysis of scientific reasoning ability and mathematics scores. *Research in Science Education*, 48(1), 151-163. <https://doi.org/10.1007/s11165-016-9563-5>
- [25] Wati, M., Hartini, S., Hikmah, N., & Mahtari, S. (2018, March). Developing physics learning media using 3D cartoon. In *Journal of Physics Conference Series* (Vol. 997, No. 1). <https://doi.org/10.1088/1742-6596/997/1/012044>
- [26] Zhou, S., Han, J., Koenig, K., Raplinger, A., Pi, Y., Li, D., ... & Bao, L. (2016). Assessment of scientific reasoning: The effects of task context, data, and design on student reasoning in control of variables. *Thinking skills and creativity*, 19, 175-187. <https://doi.org/10.1016/j.tsc.2015.11.004>

6 Authors

Mustika Wati is a senior lecturer at Physics Education Study Program. She holds a doctors degree in education research and evaluation. She is a research area of focus is physics education. (mustika_pfis@ulm.ac.id)

Saiyidah Mahtari is a lecture at Physics Education Study Program, FKIP Universitas Lambung Mangkurat. She holds a masters degree in Science Education. She is a research area of focus is physics education.

Sri Hartini is a senior lecturer at Physics Education Study Program. She holds a masters degree in Physics. She is a research area of focus is physics education. (srihartini_pfis@ulm.ac.id)

Heny Amalia is a college student at Physics Education Study Program.

Article submitted 2019-04-29. Resubmitted 2019-06-04. Final acceptance 2019-06-07. Final version published as submitted by the authors.

paper bu Mustika

ORIGINALITY REPORT

15%

SIMILARITY INDEX

9%

INTERNET SOURCES

8%

PUBLICATIONS

10%

STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

1%

★ Submitted to Seminole Community College

Student Paper

Exclude quotes On

Exclude matches < 10 words

Exclude bibliography On