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Profile of Critical Thinking Ability in Ecosystem Materials using the Rasch Model

Irmansyah Kararoor[1*], Tri Jalmo[1]

[1] Department of Natural Science Teaching, Faculty of Teacher Training and Education, University of Lampung, Bandar Lampung Indonesia.

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Abstract: This study aims to determine the ability of students in solving critical thinking questions. There are 20 multiple choice questions as an instrument of critical thinking questions. The test was carried out in class VII SMP Yapis Manokwari which consisted of 23 students. This research is a descriptive study using the Rasch model with winstep software. The results showed that the average score of students in solving critical thinking questions reached 57%. The Rasch model shows that students 23, 04, and 21 have high intelligence, while students 05, 08, 03, 10, 17, 01, 15, 19, 11, and 18 have the lowest abilities. The results showed that the ability of students to solve critical thinking questions was still in the low category. This can be used as an evaluation description for teachers to improve students' critical thinking skills.

Keywords: Critical thinking skills; Rasch model; Ecosystem Materials

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Introduction

The quality of human resources has a significant influence on the progress of a nation. The quality of human resources depends on the quality of education. Education is essential in developing human potential through a structured learning process in accordance with government regulations so that it can meet the needs of life (Syafitri et al., 2021). One of the things that support the life needs of students is the achievement of critical thinking skills, which is one of the skills in the 21st century or 4C, which includes creative thinking, critical thinking and problem-solving, communication (communication), collaboration (Partono et al., 2021).

However, the reality of education in Indonesia is still relatively low. This can be seen from the results of the 2018 Program for International Student Assessment (PISA) survey published in March 2019 for the science performance category. Indonesia is ranked 9th from the bottom, with an average score of 396 (Kaselin, 2013). These problems illustrate that education goals in Indonesia have not been achieved. Developing students' critical thinking skills is one of education's primary goals (Kaleiloglu & Gulbahar, 2014). Critical thinking is an essential skill for students (Bustami et al., 2018; Abed et al., 2015; Wartono, 2018). According to Siswono (2018), critical thinking is a process of using thinking skills effectively to help someone make something, evaluate, and apply decisions according to what is being done. Critical thinking is reasoned and reflective thinking that emphasizes deciding what to believe and do (Novitasari, 2015). Critical thinking skills do not only emphasize reflecting, synthesizing information, and drawing conclusions but also enable students to do good evaluations in class and everyday life (Utami et al., 2017).

Critical thinking ability is an important aspect, but the development of students' critical thinking skills in Indonesia is still relatively low. The development of critical thinking skills of students as the nation's next generation is necessary to face the world's challenges. Based on research, Trends in International Mathematics and Science Study (TIMSS) measures the critical thinking ability of junior high school students in Indonesia with the characteristics of high cognitive level questions showing that they consistently fall in the lower

* Corresponding Author: irmansyah.kararoor21@students.unila.ac.id

ranks (Karim & Normaya, 2015). In addition, research conducted by Wulandari et al. (2015) shows that the thinking ability of students is low. This is relevant to the research conducted by Muhlisin, (2012). Namely, the thinking ability of 80.90% of students is included in the low category. Another study conducted by Fuad et al. (2017) showed that biology students' average critical thinking ability only scored 21.89 and was categorized as low. Therefore, efforts are needed to strengthen the development of critical thinking skills in the learning process.

This study aims to determine the profile of critical thinking skills at Yapis Manokwari Middle School, West Papua. This research is expected to help develop students' critical thinking skills.

Method

This research was conducted at Yapis Manokwari Middle School, located in Manokwari Regency, West Papua Province. This type of research is descriptive research which aims to describe the critical thinking skills of students on ecosystem materials. The subjects of this study were 23 students of class VII consisting of 9 male students and 14 female students. The test instrument consists of 20 multiple choice questions referring to critical thinking indicators according to Ennis with a cognitive level of Bloom's Taxonomy C4-C6.

The data analysis technique in this study is the Rasch model with winstep software to get the logit value. The Rasch model is an analytical tool that can test the reliability and validity of research instruments, and even test the suitability of student responses and items simultaneously (Boone et al,. 2014). The Rasch model was developed by Andrich based on two basic aspects, namely the individual's ability level and the item's difficulty level to be approved (Misbach & Sumintono, 2014).

Result and Discussion

Based on the results of the analysis using the Rasch model with winstep software, various information was obtained in terms of items and respondents. The results of the reliability analysis of the items are shown in the summary statistics which can be seen in Table 1.

Table 1. Student Reliability and Critical Thinking Question Items Result

Variable	Average logit (SD)	Separation	Reliability	α Cronbach
Students	0.71 (1.40)	1.96	0.79	0.84
Test Items	0.58 (1.16)	2.00	0.80	-

The results of the Summary Statistics presented in Table 1 show that the average logit value of students is 0.71 and the standard deviation is 1.43. While the average value of the item questions is 0.58 and the standard deviation value is 1.16. It can be concluded that both student variables and question items based on the Logit Average (SD) aspect are in the ideal category (ideal value if > 0.50). Separation of student variable values is 1.96 and item questions are 2.00. This shows that the student variable is less than ideal (ideal separation value is above 3.00), while the item variable has an ideal value. The student's reliability value is 0.79 and the question item is 0.80. The reliability values of the two variables are in the sufficient category, because they are in the range of values (0.67-0.80). Cronbach's value indicates that the overall reliability of students and item items is in the very good category because it has a value > 0.80.

In addition to analyzing reliability, it is also necessary to conduct a validity analysis to explain the interaction between students (person) and scale items/items (test items). The tables used in the winstep software are Item undimensionality and Item Fit Order. The output is a usability display for testing instrument items, such as which instrument items are appropriate for measuring what should be measured. Information on instrument validity criteria can be seen in Figure 1.

```
    Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units
                                        Eigenvalue   Observed   Expected
Total raw variance in observations     =     33.0487 100.0%         100.0%
  Raw variance explained by measures   =     13.0487  39.5%          37.5%
    Raw variance explained by persons  =      5.2813  16.0%          15.2%
    Raw Variance explained by items    =      7.7674  23.5%          22.3%
  Raw unexplained variance (total)     =     20.0000  60.5% 100.0%   62.5%
    Unexplned variance in 1st contrast =      3.6142  10.9%  18.1%
    Unexplned variance in 2nd contrast =      2.8494   8.6%  14.2%
    Unexplned variance in 3rd contrast =      2.6409   8.0%  13.2%
    Unexplned variance in 4th contrast =      1.9069   5.8%   9.5%
    Unexplned variance in 5th contrast =      1.6351   4.9%   8.2%
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Figure 1. Output Item Undimensionality on Winstep

It can be seen in Figure 1 that the raw variance column is explained by measure where the score is 39.50% or in the ideal category (ideal if > 20.00%). Column unexplened variance in 1st contrast where the

eigenvalue score is 3.6142 and the observed score is 10.90% or in the ideal category (ideal if < 15.00%). Therefore, these results indicate that the instrument used shows the ideal unidimensionality.

Furthermore, after the item undimensionality stage, it is continued with item fit order with the aim of seeing the item in question functioning normally or not taking measurements. The results of the analysis of the level of suitability of the items can be seen in Figure 2.

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
6	3	23	1.94	.69	.87	-.17	2.15	1.22	A .34	.38	90.9	86.8	S6
4	7	23	.54	.53	1.51	1.82	2.10	2.03	B .17	.48	68.2	76.3	S4
8	2	23	2.49	.80	1.00	.19	1.86	.96	C .23	.33	90.9	90.7	S8
19	12	23	-.72	.50	1.17	.82	1.68	1.73	D .40	.52	68.2	72.7	S19
7	8	23	.27	.51	.85	-.60	1.42	1.09	E .52	.49	81.8	73.5	S7
17	12	23	-.72	.50	1.04	.27	1.30	.89	F .48	.52	77.3	72.7	S17
20	6	23	.83	.55	1.21	.78	1.03	.23	G .38	.47	68.2	79.4	S20
12	16	23	-1.76	.54	1.15	.63	1.16	.46	H .45	.52	72.7	76.9	S12
13	18	23	-2.40	.61	1.15	.53	1.14	.44	I .43	.52	86.4	82.5	S13
16	5	23	1.15	.58	1.08	.35	.85	-.04	J .42	.44	81.8	82.2	S16
2	14	23	-1.22	.51	.93	-.26	.85	-.23	j .57	.53	77.3	73.7	S2
18	8	23	.27	.51	.93	-.22	.82	-.35	i .54	.49	81.8	73.5	S18
1	7	23	.54	.53	.91	-.27	.72	-.56	h .55	.48	77.3	76.3	S1
9	7	23	.54	.53	.90	-.34	.84	-.22	g .53	.48	77.3	76.3	S9
5	13	23	-.97	.50	.87	-.57	.77	-.53	f .60	.53	81.8	73.2	S5
10	5	23	1.15	.58	.81	-.52	.85	-.04	e .51	.44	90.9	82.2	S10
14	15	23	-1.48	.52	.81	-.78	.65	-.64	d .63	.53	77.3	74.7	S14
11	11	23	-.48	.49	.80	-.99	.68	-.97	c .63	.52	77.3	72.0	S11
3	15	23	-1.48	.52	.73	-1.17	.62	-.72	b .66	.53	86.4	74.7	S3
15	4	23	1.51	.63	.61	-1.10	.47	-.61	a .59	.42	95.5	84.5	S15
MEAN	9.4	23.0	.00	.56	.97	-.08	1.10	.21			80.5	77.7	
P.SD	4.6	.0	1.29	.07	.20	.74	.49	.84			7.8	5.2	

Figure 2. Analysis Results of The Level of Appropriateness Items

According to Boone, Staver, & Yale (2014), the parameters used to determine the accuracy or suitability of the respondents consist of, first, the outfit mean square (MNSQ) value received: 0.5 < MNSQ < 1.5. Second, the value of the outfit Z-standard (ZSTD) received: -2.0 < ZSTD < +2.0. Third, the value of point measure correlation (Pt Mean Corr) is accepted: 0.4 < Pt Measure Corr < 0.85. Based on Figure 1, it can be seen that question number 4 does not fit, because the item does not meet the three criteria for the MNSQ, ZTSD, and PT Measure Corr scores.

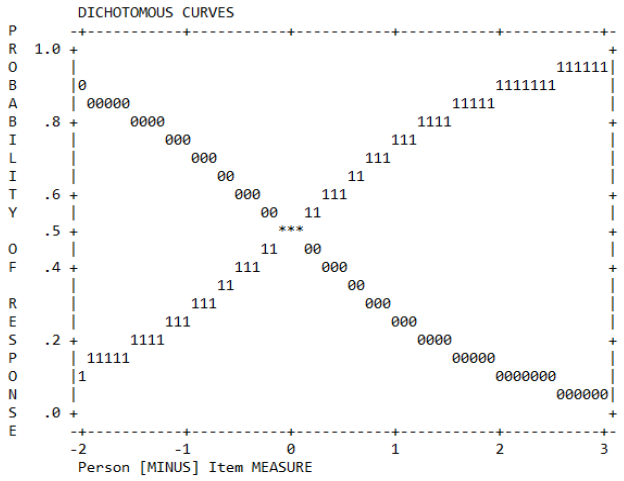

Figure 3. Results of Rating Scale Analysis

Diagnostic validity also needs to be done with the aim of knowing whether the ranking scale is monotonous or not. The results of the diagnostic validity analysis can be seen in Figure 3. It shows option 1 is the correct answer and 0 is the incorrect answer. These options are in a relative position so that they can be understood by respondents. Overall it can be concluded that the level of validity of the rating scale in this study is good.

The results of the analysis of variables (wright) maps describe the distribution of students' abilities in answering questions and the difficulty of the items. The ability of students is on the left, while the distribution of the difficulty of critical thinking questions is on the right, which is shown in Figure 4. It can be seen that the analysis of critical thinking skills with the ability distribution of 23 students shows that students with code 23 have the highest ability among 22 other students. These students get a logit value of 2 logit. Students 23, 04, and 21 are outside the limits of the two Standard Deviations (SD) marked by T. This shows that the three students have higher critical thinking skills than others. Meanwhile, students with the lowest ability criteria are coded 05, 08, 03, 10, 17, 01, 15, 19, 11, and 18 with a logit value less than -1 logit. Therefore, it can be concluded that the critical thinking ability of YAPIS Manokwari Middle School students is still in the low

category. This is also supported by the average completeness of students in solving critical thinking questions reaching 57.00%.

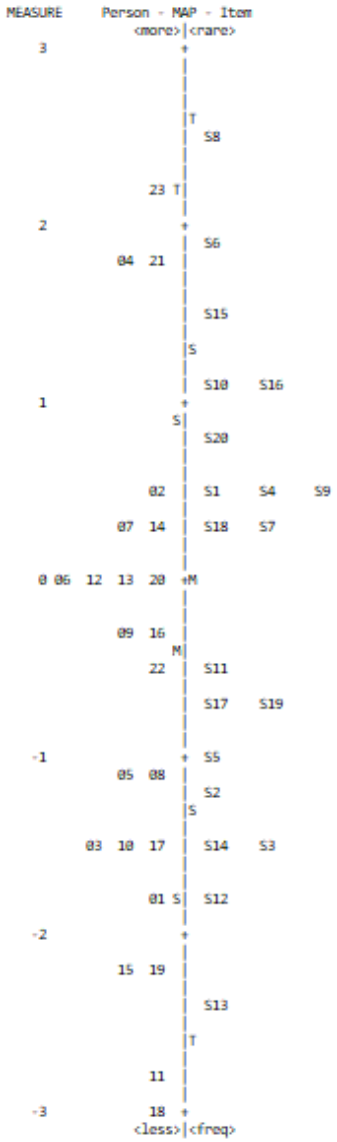

Figure 4. Overview of Critical Thinking Ability

The low ability to think critically of students is caused by the implementation of learning strategies that are not suitable. There is no habituation in practicing critical thinking skills, or students are not accustomed to dealing with questions that require critical thinking skills, there is a lack of training activities and relative learning resources, and limited time in school to develop critical thinking skills (Nurazizah et al., 2017; Saputria et al., 2018; Hidayati & Sinaga, 2019; Ebiendele, 2012). This is relevant to the PISA results from 2009-2015 for Indonesia, which show low results because students are less accustomed to higher-order thinking. Hasnunidah et al., (2015) explains that the low argumentation ability of students is one of the causes of students' low critical thinking skills. This can be seen from the weakness of several indicators, including; students still find it difficult to ask questions and define problems, problem literacy is actually still lacking, analytical and evaluative biology problem solving is still low, skills to identify, analyze, and evaluate arguments selectively are still low. The learning experience also influences the critical thinking ability of students. Therefore, it is essential to implement a learning process that provides activities or training in developing good critical thinking skills so that teachers must find learning methods that involve and train students' critical thinking skills or providing critical thinking skills questions on a non-routine basis (Emerson, 2013; Chu et al., 2017). Students with good critical thinking skills can make the students able to understand the subject matter well and become a provision for students to face and solve problems in everyday life through contextual phenomena (Hasanah, Sunarno, & Prayitno, 2020).

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