

## Analysis of the Rasch Model: Validity of Students' Mathematical Creative Thinking Ability on Quadratic Function Material

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### ABSTRACT

**Keywords:** *Creative thinking skills are important skills in the world of education, but students are less enthusiastic when solving math problems which causes students' mathematical creative thinking skills to be low. This study aims to determine the validity of students' mathematical creative thinking skills on quadratic function material with the Rasch Model. This study uses a quantitative method with a survey approach. The subjects of this study are 106 students consisting of school students, this research is carried out by testing instruments on research subjects. Through the instrument, there are four indicators consisting of eight questions that are tested for validity and bias using the Rasch Model, the results are that all items are declared fit on the validity test, 24 people are declared misfit, with a reliability test score of 0.73 including high criteria and seven items are indicated as biased items.*

**Valid;**

**Rasch Model; Creative Thinking Ability; Function of Squares**

## 1. INTRODUCTION

Creative thinking skills are one of the higher-level thinking skills that are able to find, share solutions and approaches to generate ideas and develop new ideas and strategies productively [1][2][3][4]. The ability to think creatively is a crucial skill. because it is a necessary ability in facing the era of disruption to prepare the younger generation to be able to face the global era, as well as support daily needs, both in the school environment and the world of work [2][5][2][6][7].

The ability to think creatively mathematically is very important, but this is contrary to the fact that students are still not enthusiastic when solving math problems given by their teachers, causing students' mathematical creative thinking skills to be low. This is supported by research conducted by Wardani and Suripah [8] at a specific educational institution. The findings indicate that the students' creative thinking abilities remain below average, with an average score of 29% in the eleventh grade. The lowest indicator is elaboration (13%), while the highest is flexibility (44%). Therefore, there is a need for an instrument to test the ability to think creatively with the Validity Test and the Reliability Test. Validity is the degree to which a test is able to measure exactly what it should measure[9]. A data or information is considered valid if it is consistent with the actual reality or conditions. Assessing the validity of a measuring tool involves the process of forming arguments based on empirical evidence to demonstrate the extent to which the tool effectively measures the construct or variable in question [10].

After conducting a validity test, a reliability test is carried out which leads to the accuracy and accuracy of a reliable measuring tool so that it knows how consistent it is in measuring the same symptoms [6][11][12]. When testing the validity and reliability of the instrument, there may be possible answers obtained due to the presence of respondents who cheat and different knowledge so that identical answer patterns are detected between respondents [13]. This can be measured by Differential Item Functioning (DIF) or bias items. DIF is a phenomenon in which a test item has a different probability of answering between two or more groups of students who have the same ability, but have other different characteristics, which are influenced by several factors [14]. The selection of material used in an instrument is carried out to ensure the suitability of the material studied with the knowledge of the respondents. In this study, the instrument of creative thinking ability is used on the material of the quadratic function. The quadratic function material is the material that is in phase E so that it can minimize the results of errors in answering, this can affect the results of the Reliability Validity Test and DIF. Testing in this study uses the Rasch Model with the help of Winsteps Software.

The Rasch model is a statistical analysis model used to convert raw score data into data at equal intervals, resulting in a linear, precise, and unitary measurement scale [15]. This model is very effectively used in educational assessment and evaluation for problem quality analysis, knowing the level of student ability, problem difficulty, detection of misconceptions, bias in questions, and the possibility of knowing the presence of students who cheat [5][7][16]. One of the software that can process data with the Rasch Model is Winsteps. Winsteps software is a software used to analyze data using Rasch models[15].

Based on the appropriate and relevant, this research in the last five years. The first research was conducted by Ernawati [17] this study uses the Rasch model to test the validity of content, psychometrics, and constructs of the assessment of creative thinking ability in junior high school mathematics exams. The results showed that the test instrument met the validity of the content, psychometrics, and constructs, as well as showed the creative thinking ability of students during the mathematics exam.

Based on research conducted by Susongko, et al. [18] this research uses the Rasch model to test the validity of the content, psychometrics, and constructs of environmental literacy tests based on high-level thinking skills. The results of the study show that the environmental literacy test meets the validity of content, psychometrics, and constructs, and can measure students' ability to think at a higher level. The third research was conducted by Qonitah, et al. [19] this study uses SPSS to test the validity of students' mathematical creative thinking skills on quadratic function material. The results showed that the test instrument met the validity of content, psychometrics, and constructs, as well as show students' creative thinking ability on square function material. The fourth research was conducted by Mawarni [20] This study uses Excel to test the validity of students' mathematical creative thinking skills. The results showed that the test instrument met the validity of content, psychometrics, and constructs, as well as show students' creative thinking skills.

Based on previous relevant research, the researcher discovered that the Rasch model has not been employed to assess the validity, reliability, and Differential Item Functioning (DIF) of mathematical creative thinking tests related to quadratic function topics utilizing the Winsteps application. Consequently, the objective of this study is to evaluate the validity of mathematical creative thinking questions. Additionally, the research aims at (1) Examining the Rasch model in assessing the validity of mathematical creative thinking skills. (2) Investigating the Rasch model's role in determining the reliability of mathematical creative thinking abilities. (3) Analyzing the Rasch model for potential DIF in mathematical creative thinking abilities.

## 2. RESEARCH METHODS

### 2.1 Research Design and Participants

This study utilized a quantitative research method, using a survey approach. The survey approach is the most suitable approach to identify the needs of a community and a person's opinion on a particular issue, collect data through interviews or questionnaires given to respondents [21][22][23]. Purposive sampling is a sampling technique based on the assumption that the sample possesses characteristics that are pertinent to the research objectives. [21][24]. The subjects in this research are 106 with the following categories.

**Table 1. Participants**

Demographics	Description	Code	Quantity
Age	16	A	15
	17	B	29
	18 years and older	C	62
Domicile	Jakarta	D	70
	Bogor	E	24
	Depok	F	4
	Bekasi	G	5
	Tangerang	H	3
Gender	Male	L	56
	Female	P	50

Table 1, in the description column, the researcher classifies the respondents' information into several categories, namely age, domicile and gender. The respondents totaled 106 people with an age range between sixteen and eighteen years old, and domiciled in Jakarta, Bogor, Depok, Bekasi. This information is taken from the answer sheet of the participant's identity section.

### 2.2 Instrument

The present study employed indicators of mathematical creative thinking ability. The indicators are:

**Table 2. Instrument**

Num	Aspects of Mathematical Creative Ability Indicators	Description	Scoring	Score
1.	Fluency	The students can give more than one answer to the given question.	Students give blank answers that are not in accordance with the problem asked.	0
			Students convey ideas that are inappropriate and irrelevant to the solution of the problem	1
			Students provides ideas relevant to problem solving, but does not produce the correct answer	2
			Students gives a suitable idea but the answer is wrong	3
			Students give appropriate answers with appropriate and correct solutions.	4

Num	Aspects of Mathematical Creative Ability Indicators	Description	Scoring	Score
2.	Flexibility	Students can generate varied and diverse ideas to find answers.	Students does not provide an answer or answers in various ways, but the answer is not correct.	0
			Students answer the question with one variety, but the answer is not correct.	1
			Student gives an answer with one variety, using calculations that produce the correct answer.	2
			Students gave a variety of answers but made mistakes in the calculation process so that the results were not correct.	3
3.	Originality	Students can give answers in a unique and different way.	Students provide answers with many variations, and use precise calculations and correct answers.	4
			Students do not give answers according to the questions tested.	0
			Students provide answers in a creative way but are difficult to understand.	1
			Students give answers by means of calculation, but have not completed the calculation process.	2
4.	Elaboration	Students provide developing various ideas when answering a question or problem.	The students provided disparate responses, and the erroneous calculation steps resulted in an incorrect answer.	3
			Students are able to answer with calculation steps so that the answer results are correct.	4
			Students do not provide answers, or do not match the questions asked.	0
			Students in answering without a detailed explanation.	1
			The student answered with details that were not detailed enough and the result was wrong	2
			Students answered with detailed details but there were errors in answering.	3
			Students provide accurate answers with complete explanations.	4

Reference Sources: [25]

Table 2 shows the instruments used in this study. The instrument in this study is the ability to think creatively mathematically which has four aspects of indicators, namely fluency, flexibility, originality and elaboration, each aspect has four scores that are adjusted to the indicators of creative thinking. The instrument that has been prepared is then used as a test guideline, a test is one of the tools or procedures used to measure or know an aspect in an individual or group, in a way and rules that have been determined [26]. The instrument in this study has gone through several stages, the first is construction validation. Construct validation is observing whether the instrument can measure the concept or construct being measured [27]. This constitutional validation involves lecturers and mathematics education. The results are as follows.

The sum of the two positive numbers is 12 and the sum of the squares of the two numbers is the sum of the squares of the two numbers minus 40. Determine the difference between the two numbers in a variety of ways. What is the difference from the number in different ways?	The sum of the two positive numbers is 12 and the sum of the squares of the two numbers is the sum of the squares of the two numbers minus 40. Determine the difference between the two numbers in a variety of ways.
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(a) (b)  
**Figure 1. (a) before validation; (b) after validation**

Figure 1 there is a change before and after the validity of the construct, the change is in the choice of word diction in the section "determine the difference between the two numbers in various ways" to "determine the difference between the two numbers". In addition, there is a change in the reduction of the sentence "what is the difference from the two sides in various ways". The reduction in the sentence is an adjustment of the indicator of creative thinking problems, namely the Flexibility Aspect. Thus, construct validation is carried out and instruments are tested on respondents, the results are collected and content validation is carried out. Content validation is a process carried out to ensure that the content of an instrument, such as a questionnaire, module, or questionnaire, is of high quality and relevant to the intended purpose [28].

### 3. RESULTS AND DISCUSSION

#### 3.1 Validity

This study is to measure the validity of using the Rasch model with the Winsteps application. if an item is valid then it meets the validity criteria set out in the Rasch analysis. In other words, the item can be considered valid if it meets the standards or criteria that have been set in the Rasch validity test procedure. To test the validity of Rasch using Winsteps based on Item dan person fit and the misfit. An item or person fit if it meets three criteria, namely MNSQ Outfit at 0.5 – 1.5, ZSTD Outfit at -2.0 – +2.0 and PTMEA-CORR at 0.4 – 0.85 [7]. The following are the results of item and person data.

**Table 3. Item Validity Analysis Results**

Entry Number	Item	Outfit MNSQ	Outfit ZSTD	Pt Mean Corr
1	I1	0.83	-1.2	0.54
2	I2	0.91	-0.5	0.54
3	I3	0.85	-1.1	0.66
4	I4	1.14	1.0	0.54
5	I5	1.23	1.6	0.54
6	I6	1.14	1.0	0.55
7	I7	1.01	0.1	0.58
8	I8	1.03	0.3	0.58

Based on the results of the analysis of the mathematical creative thinking test items in Table 3, it was found that when analyzing the quality of the questions using the Rasch model. Based on the fit item criteria, there are 8 questions that are considered valid and no questions that are misfit [7]. Based on this, the correlation is positive and consistent in each item [29].

**Table 4. Misfit Order of The Person**

No	Person	MNSQ	ZSTD	Pt Mean Corr
1	014CEP	<b>1.48</b>	1.2	0.04
2	015CEL	<b>1.29</b>	0.7	0.84
3	016CHP	<b>1.74</b>	1.3	0.06
4	018CDP	<b>2.10</b>	<b>2.1</b>	0.08
5	020CEP	<b>3.38</b>	<b>2.4</b>	0.34
6	025CEP	<b>1.48</b>	1.2	0.33
7	032CEL	<b>2.53</b>	1.4	0.39
8	033CDL	<b>1.85</b>	1.7	0.41
9	034CDL	<b>2.46</b>	<b>2.7</b>	0.03
10	035CEL	<b>2.29</b>	<b>2.6</b>	0.09
11	036BDP	<b>3.57</b>	<b>2.7</b>	0.45
12	039CEP	<b>1.71</b>	1.6	0.06

No	Person	MNSQ	ZSTD	Pt Mean Corr
13	044AGP	<b>1.51</b>	1.0	0.51
14	056ADL	<b>1.53</b>	1.1	0.20
15	080ADL	<b>2.37</b>	1.6	0.57
16	085BDL	<b>2.16</b>	<b>2.1</b>	<b>0.03</b>
17	090CDP	<b>1.68</b>	1.6	0.58
18	093CEL	<b>2.08</b>	1.5	0.45
19	090CDP	<b>1.68</b>	1.6	0.58
20	098CDP	<b>1.82</b>	1.3	0.31
21	099CEL	<b>2.16</b>	<b>2.1</b>	<b>0.03</b>
22	100CEP	<b>1.69</b>	1.3	0.45
23	104CDL	<b>1.66</b>	1.5	0.12
24	106CDP	<b>1.73</b>	1.5	<b>0.03</b>

As per the results of analysis using the Rasch model in Table 4, it was found that 18 persons who were misfitted, indicated by a orange box mark representing a person exceeding or less than the specified criteria, this can be caused by a mismatch between individual characteristics and the environment or organization [30] The number of people who missed the three fit criteria was 10 people, the number of people who did not meet the two fit criteria was seven people, and the number of people who did not meet one fit criteria was seven people. Therefore, based on the three criteria of person fit, the number of misfit persons is 24 persons [7].

### 3.2 Reliability

Based on this study, the reliability test is displayed in the Summary table, namely in the Cronbach Alpha (KR-20) section, individual reliability items, and individual separation items. Reliability Analysis output using the Rasch model with Winsteps application was used. The results are displayed as follows:

**Table 5. Review of Output Summary Statistics**

Statistics	Value
(KR-20)	0.73
Person Reliability	0.71
Item Reliability	0.91
Person Separation	1.58
Item Separation	3.20

Based on Table 7, the value of the Alpha Cronbach instrument (KR-20) of 0.73 can be seen that 0.73 is greater than 0.7 in the high category [29]. This shows that the instrument has good quality in distinguishing between different respondents [31].

### 3.3 Differential Item Functioning (DIF)

Context of content validation, "DIF" stands for "Differential Item Functioning" which means the function of the item that is different between different groups. DIF occurs when test items have different effects on different groups, such as ethnicity, gender, or age, so they can affect the test results [32]. A question item is said to be biased if it is found that individuals with certain characteristics gain more advantages than individuals with different characteristics [33] The results of DIF in this study are as follows:

**Table 6. Data Item DIF**

Num	Item	Class	DIF Measure	DIF Contrast	t	Probability
1.	I1	Z	-0.05	0.24	0.71	0.4977

Num	Item	Class	DIF Measure	DIF Contrast	t	Probability
		K	0.19	-0.24	-0.71	0.4977
2.	I2	Z	-0.36	0.77	2.28	0.0458
		K	0.41	-0.77	-2.28	0.0458
3.	I3	Z	-0.58	0.09	0.25	0.8072
		K	-0.49	-0.09	-0.25	0.8072
4.	I4	Z	0.54	-0.37	-0.99	0.3501
		K	0.16	0.37	0.99	0.3501
5.	I5	Z	0.06	-0.40	-1.18	0.2665
		K	-0.35	0.40	1.18	0.2665
6.	I6	Z	-0.36	0.17	0.49	0.6335
		K	-0.20	-0.17	-0.49	0.6335
7.	I7	Z	0.17	-0.33	-0.96	0.3610
		K	-0.17	0.33	0.96	0.3610
8.	I8	Z	0.68	-0.26	-0.64	0.5353
		K	0.42	0.26	0.64	0.5353

Question items indicated by DIF if the analysis threshold for DIF analysis includes the DIF contrast value must be higher than 0.5 and the probability value is less than 0.05 [34]. Table 6 in the DIF contrast value section only question item number 2 that meets the criteria of more than 0.5 with a value of 0.77, while the rest are still below 0.5. Meanwhile, in the probability section, there are 5 questions that meet the criteria, namely no 2, 3, 5, 7 and 8. So there is an indication of DIF in question no. 1, 4 and 6.

#### 4. CONCLUSIONS

Based on the validity calculation using Winsteps, it was found that the instruments about creative thinking skills made had a good level of validity, all items are declared fit with an overall acceptable value from the three existing criteria, there were 24 persons who misfit from three criteria, ten of whom did not meet three criteria, seven persons did not meet two criteria and seven other persons did not meet one existing criterion. The reliability test shows an Alpha Cronbach value of 0.73 with a high category. As for the Bias or DIF test, there are seven questions that indicate bias from two criteria, four of which do not meet one criterion and the other three do not meet all existing criteria.

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