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BASIC ALGEBRA ABILITY ANALYSIS OF JUNIOR HIGH SCHOOL STUDENTS WITH THE RASCH MODEL APPROACH

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ABSTRACT

The purpose of this study was to determine students' basic algebraic abilities based on the analysis of the items (items) and the analysis of students' abilities (person) using the Rasch modeling. The instrument used was a test instrument in the form of multiple choices about algebraic material. This test was given to 662 students of class VIII and IX at SMP Negeri 5 Kendari. Data analysis was performed by RASCH modeling using the Winstep application.The results of the person analysis stated that the overall ability of the students was greater than the difficulty level of the questions. The basic Algebra ability possessed by all students are higher than the difficulty level of all the algebra questions tested. This shows that the consistency of students' answers in solving multiple choice questions on algebraic material according to the level of difficulty is strong or good, but the quality of the items used in collecting data on students' algebraic abilities is of moderate quality.

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1. INTRODUCTION

Technological developments become a reference for change and education reform to continuously adjust and improve the curriculum in responding to future challenges. With the emergence of the Independent Campus Learning Center (MBKM), it requires elements of education to carry out and respond to increasingly stringent challenges in the future. The

quality of education is of course the main goal of education in Indonesia, so as to achieve this. It is necessary to analyze student learning outcomes using standardized tests. This is due to the fact that there are still many teachers who use questions from textbooks that are already available for which the quality and reliability of the test questions are not known (Rustam & Kasmawati, 2021).

The quality of education cannot be separated from the learning process in the classroom and a good evaluation process. To form students' critical thinking skills requires great effort for educators. The ability to think critically one of the most relevant subjects is mathematics. Mathematics lessons are still very much a hot topic of conversation in the classroom. Various challenges arise both from students, teachers, that the available means. Mathematics is an abstract science and not everyone likes it. This is shown from the results of Chotimah's research, it was found that junior high school students' mathematical understanding was still low (Chotimah, 2014).

Learning mathematics, especially certain materials, requires serious understanding in understanding the concept. Mathematics teaches something abstract, especially in algebra material. Algebraic material contains abstract symbols and requires a sufficient understanding of ability to learn it. The results of Male's research, in students at one of the junior high schools found that in one class consisting of 35 students, only 5 students were already at the formal (abstract) thinking stage, while 30 students were at the concrete operational thinking stage, so they had difficulty understand mathematical concepts that are still abstract to them (Putra, 2014).

Algebra material in mathematics lessons offers a variety of abstract concepts. One that is sometimes difficult for students to understand is the laws of algebra, so that in algebraic operations students often make mistakes in solving a problem.

Of course, as a teacher, you must be able to identify student weaknesses in solving a problem in teaching material, especially those related to the basic concepts of algebra, namely algebraic laws. Understanding the laws that apply to algebraic operations will make it easier for students to solve problems with various forms of problems. Symbols have different interpretations so students have the opportunity to experience misconceptions (Afriansyah, 2016; Nurmawanti & Sulandra, 2020). Utami (2017) explained, that students experience misconceptions in adding and subtracting coefficients with constants. In addition to that algebraic concepts are closely related to problems in everyday life that are encountered by students, the inculcation of the initial concept for material in algebraic forms in junior high school students is very important because it is still fundamental (Utami, 2017).

Early detection of students' abilities and understanding of basic algebraic concepts is the best alternative so that students have no difficulty learning further material, especially those related to algebraic operations that use abstract symbols. It is necessary to analyze students' abilities, to what extent they understand the basic algebraic concepts. To measure basic algebra ability students must use test instruments that can provide accurate information according to the actual conditions of students. In order to be able to help students appropriately, it is necessary to know in advance whether the difficulties or problems faced by these students are then analyzed and formulated solutions (Iriyadi et al., 2022).

This research will analyze students' basic algebraic abilities based on the analysis of items (items) and analysis of students' abilities (person). Item analysis explains the contribution of the test instrument in explaining students' algebraic abilities in solving basic algebraic concepts. Analysis of students' abilities shows students' algebraic abilities in solving algebraic concepts, especially those related to algebraic laws. Item analysis and student ability analysis were simultaneously carried out using the RASCH model.

Rasch modeling will provide valid information in demonstrating students' basic algebraic abilities. Rasch modeling will create a hierarchical relationship between the examinee (person) and the items used. Because it produces the same interval scale with the same logit units for the person and the items (Kurniawan & Andriyani, 2018). In addition, the Rasch Model approach is due to: (1) being able to predict missing data scores based on systematic response patterns, (2) being able to identify person capabilities through identification of error responses, (3) being able to identify guesses, (4) being able to analyze person abilities which does not depend on the number of correct answers, and (5) is able to make a measurement scale with the same interval (Sumintono & Widhiarso, 2015). The purpose of this study was to determine students' basic algebraic abilities based on the analysis of the items (items) and the analysis of students' abilities (person) using the Rasch modeling. The purpose of this study was to analyze the basic algebra ability of junior high school students using the Rasch Model approach.

2. METHOD

This research was conducted at SMP Negeri 5 Kendari. Algebra material has been taught in schools since class VII, so the class that is used as a respondent is students in class VIII and IX with the assumption that students have studied algebra material. Therefore, the research respondents in the study were 662 students.

The research instrument used is a test instrument in the form of multiple choices about the basic concepts of Algebra. The test items consist of fifteen numbers that measure students' basic algebraic abilities and their understanding of algebraic laws. Data is taken based on the scores obtained by students from the results of examining their answer sheets.

Giving scores on student answer sheets based on the multiple-choice assessment rubric is true or false according to the answer key. Mok and Wright explained that the concept of objective measurement in educational assessment must have five criteria, namely "(1) Provide a linear measure with the same intervals, (2) Carry out an appropriate estimation process, (3)

Find items that are incorrect (misfits) or unusual (outliers), (4) Overcome missing data, (5) Produce replicable measurements (independent of the parameters studied). Based on these five conditions, so far only the RASCH model can meet these five conditions." (Sumintono, 2021).

Objective measurement, as well as application of the Rasch Model in educational assessment with the use of software or applications designed for Rasch modeling (Bond & Fox, 2007). The data obtained were analyzed using RASCH modeling with the help of WINSTEPS software. Data on students' basic Algebra ability test scores in Microsoft Excel format were prepared and after that the data type was adjusted to the WInsteps program, namely using the file type "*.prn" which can be read through the notepad program. The data analysis process then prepares the data format in the Ministep program for modeling

RASCH. The results of research data analysis using RASCH modeling are carried out as follows:

a. Analysis of the WRIGHT Map (person-item map), which is a map that describes the distribution of students' abilities and the level of difficulty of the questions on the same scale.
b. The analysis of the items includes the level of difficulty of the items (item measure), the level of suitability of the items (item fit) and the detection of biased items.
c. Analysis of student capabilities includes the level of individual ability (pearson measure), the level of individual suitability (person fit)

d. Instrumental analysis is a comprehensive analysis with RACH modeling as a whole with more detail in the form of statistical summaries and test information functions that will guide researchers in making appropriate, logical and scientific decisions.

3. RESULTS AND DISCUSSION

3.1. Wright Map Analysis (Person – Item Map)

Analysis of the ability of Algebraic concepts possessed by 662 students in grades VIII and IX of junior high school. The understanding of algebraic laws is described comprehensively in the RASCH model through Wintesp's output, namely the Wright map as shown in Figure 1.

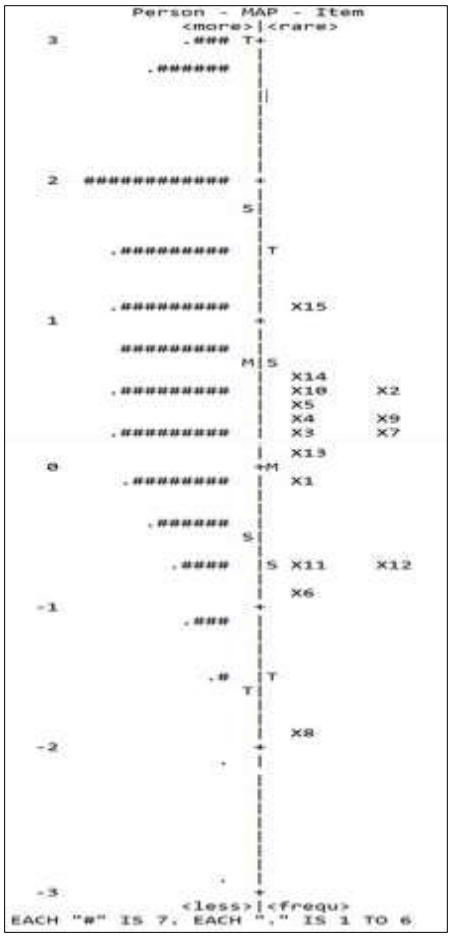

Figure 1. Wright Map (Person – Item Map)

The highest level of students' basic algebraic ability reached the maximum logit number, namely there were 25 people who answered all of them correctly including students in the order of 107, 126, 194, and so on with an ability logit of +3.00 logit. The student is able to answer Algebra questions well. While those who answered 14 numbers correctly were 43 students with a logit ability of +2.00 logit. Furthermore, those who answered 13 numbers correctly were 84 students with a logit ability of less than 2.00 logit. While those who were able to answer 12 numbers correctly were 68 students with an ability logit of +1.00 logit.

The students' basic algebraic ability level was the lowest and only able to answer 1 number correctly as many as 4 students with a logit ability of -1.00 logit. Likewise, the

number of correct answers between 2 to 7 is still relatively small with a logit ability of around +0.00 logit.

The average value of the logit person (0.69 logit), while the average item (0.00 logit) on the Wright map shows that the ability of all students' basic Algebraic is higher than the level of difficulty of all the algebraic questions tested.

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The students' algebraic ability level was the lowest and only able to answer 1 number correctly as many as 4 students with a logit ability of -1.00 logit. Likewise, the number of correct answers between 2 to 7 is still relatively small with a logit ability of around +0.00 logit.

The average value of the logit person (0.69 logit), while the average item (0.00 logit) on the Wright map shows that the ability of all students' Algebraic concepts is higher than the level of difficulty of all the algebraic questions tested.

3.2. Item Analysis

The RASCH model is used to analyze the item items indicated by the output of the item measure table, the measure values in table 1 show the order of difficulty level of questions number 1 to 15, question 15 with the highest level of difficulty (1.08 logit), then questions 14,2 , and 10 have a difficulty level range (+0.5 logit) and questions with a difficulty level range (+0.2 logit) are at numbers 4, 3, and 7. Finally, the items are at the lowest level of difficulty, namely (-1,92 logit) is at number 8. The responses given by students to each question tested can be seen in the total score column in table 1.

Table 1. Item Measures

Item STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
15	296	662	1.08	.09	1.00	.0	1.06	1.0	.49	.49	68.3	70.7	X15
14	360	662	.56	.09	.97	-.8	.97	-.5	.50	.48	72.5	69.9	X14
2	367	662	.51	.09	1.08	2.2	1.13	2.4	.42	.48	66.7	69.9	X2
10	367	662	.51	.09	1.09	2.5	1.09	1.7	.42	.48	65.8	69.9	X10
5	375	662	.44	.09	.96	-1.2	.96	-.8	.50	.48	73.5	70.0	X5
9	390	662	.32	.09	1.22	5.5	1.33	5.4	.32	.47	63.9	70.4	X9
4	396	662	.27	.09	.90	-2.7	.84	-2.9	.54	.47	72.7	70.5	X4
3	400	662	.24	.09	1.00	.1	.98	-.2	.47	.47	70.8	70.6	X3
7	400	662	.24	.09	.88	-3.4	.86	-2.6	.55	.47	75.5	70.6	X7
13	411	662	.15	.09	1.01	.4	1.03	.6	.45	.46	69.4	70.9	X13
1	446	662	-.15	.09	.93	-1.6	.90	-1.4	.49	.45	75.2	72.9	X1
11	500	662	-.65	.10	.95	-.9	.89	-1.2	.45	.41	78.5	77.6	X11
12	501	662	-.66	.10	1.01	.2	1.06	.7	.40	.41	78.6	77.7	X12
6	527	662	-.94	.11	.99	-.2	.89	-1.0	.40	.39	81.8	80.7	X6
8	595	662	-1.92	.14	.93	-.7	1.07	.5	.33	.31	90.4	89.8	X8
MEAN	422.1	662.0	.00	.10	1.00	.0	1.01	.1			73.6	73.5	
S.D.	75.1	.0	.73	.01	.08	2.1	.12	2.0			6.7	5.5	

In this study there were 662 respondents with a total of 15 items. From the results of the item analysis, it shows that the difficulty level criteria are divided into five categories. Items are categorized as easy if they have a b value close to -2.00 logit , items are categorized as moderate if -1.00 logit <b < +1.00 logit and items are categorized as

difficult if the b value is close to +2.00 logit. Furthermore, items with a value of b > +2.00 logit are in the very difficult category and b values < -2.00 logit are in the very easy category (Sari et al., 2021). The following table 1 column 4 shows the difficulty level of the item. Based on table 1, it is found that all items fall into the moderate category, except item number 8, which is the easy category**.**

3.3. Differential Item Functioning (DIF) Analysis

Analysis of differential item functions or Differential Item Functioning (DIF) really needs to be done to prevent fraud in certain groups. Good test items will provide accurate information from the test results. In this case, the item does not benefit one particular group, so the item is accurate in measuring the respondent's ability data (Rustam et al., 2019). Following are the results of the Differential Item Functioning (DIF) analysis

Table 2. DIF class specifications

Person CLASSES	SUMMARY DIF CHI-SQUARE	D.F.	PROB.	BETWEEN-CLASS MEAN-SQUARE	t=ZSTD	Item Number	Name
2	.1110	1	.7390	.0556	-.8404	1	X1
2	.0000	1	1.0000	.0121	-1.1626	2	X2
2	.0860	1	.7693	.0430	-.9065	3	X3
2	.3819	1	.5366	.1913	-.4276	4	X4
2	1.1255	1	.2887	.5643	.1030	5	X5
2	3.3477	1	.0673	1.6775	.8706	6	X6
2	1.4351	1	.2309	.7195	.2510	7	X7
2	.3466	1	.5560	.1718	-.4706	8	X8
2	.3919	1	.5313	.1963	-.4171	9	X9
2	1.9818	1	.1592	.9946	.4676	10	X10
2	9.8229	1	.0017	4.9724	1.9708	11	X11
2	13.1615	1	.0003	6.6925	2.3477	12	X12
2	2.2460	1	.1340	1.1271	.5577	13	X13
2	.1743	1	.6763	.0873	-.7088	14	X14
2	.0941	1	.7590	.0471	-.8837	15	X15

Based on the table above, it can be seen that there are two items whose probability value is <0.05, namely numbers 11 and 12. These two items are not good at collecting data because they have the potential to benefit one of the sexes or it is said that the two items have different functions or Differential Item Functioning (DIF) occurs. Questions 11 and 12 are questions that measure the basic algebraic abilities of the Associative and Commutative Laws. Thus, the form of this question needs to be revised so that it does not benefit one sex group.

3.4. Student Ability Analysis

Based on the results of the RASCH modeling, students' basic algebraic abilities are shown in the person measure value, based on the MST distribution the highest student ability is 4.09 logit, namely students 107th, 126th, 196th, …, totaling 24 students. The lowest students' abilities or abilities with a value of -2 .90 logit, namely students with serial numbers 433, 410, 271, and 18. Then the person (person) is said to fit the model if the MNSQ value is between 0.5 < MNSQ < 1.5 , ZSTD values are between -2 < ZSTD < 2, and Point Measure Correlation (Pt Mean Corr) values are not negative or are between 0.4 < Pt Measure Corr < 0.85 (Sari et al., 2021).

Based on the analysis of the person fit order table in the RASCH modeling, 92.74% of students had response patterns that matched the model, but there were several students

who had response patterns that did not fit the model because they did not meet the criteria for person fit indicators

3.5. Instrument Analysis

The overall instrument analysis in the RASCH modeling provides information about the quality of student response patterns, the quality of the instruments and the interactions between persons and items.

Table 3. Summary of 637 Measured (Non-Extreme) Persons

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	9.4	15.0	.69	.64	1.00	.1	1.01	.1
S.D.	3.1	.0	1.15	.14	.15	.7	.44	.8
MAX.	14.0	15.0	2.82	1.07	1.72	4.1	7.70	3.7
MIN.	1.0	15.0	-2.90	.54	.59	-2.0	.38	-1.8
REAL RMSE	.68	TRUE SD	.92	SEPARATION	1.36	Person RELIABILITY		.65
MODEL RMSE	.66	TRUE SD	.94	SEPARATION	1.42	Person RELIABILITY		.67
S.E. OF Person MEAN = .05								

Table 4. Summary of 4 Measured (Non-Extreme) Items

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	422.1	662.0	.00	.10	1.00	.0	1.01	.1
S.D.	75.1	.0	.73	.01	.08	2.1	.12	2.0
MAX.	595.0	662.0	1.08	.14	1.22	5.5	1.33	5.4
MIN.	296.0	662.0	-1.92	.09	.88	-3.4	.84	-2.9
REAL RMSE	.10	TRUE SD	.72	SEPARATION	7.36	Item RELIABILITY		.98
MODEL RMSE	.10	TRUE SD	.72	SEPARATION	7.45	Item RELIABILITY		.98
S.E. OF Item MEAN = .19								

The person measure value of 0.69 logit shows the average value of 662 students who answered the given items. The average score of students' abilities that is less than the item measure 0.00 logit indicates that students' basic algebraic abilities in solving multiple choice items about algebraic material greater than the difficulty level of the multiple choice questions given and basic algebraic abilities of students are still in the low category. As stated by Anggara and Abdillah (2022) that a high person's ability is an ability with a logit value above 0 while a low person's ability is an ability with a logit value below 0

This shows that the consistency of students' answers in solving multiple choice questions on algebraic material according to the level of difficulty is strong or good, but the quality of the items used in collecting data on students' algebraic abilities is of moderate quality. Cronbach's alpha value of 0.74 stated that the interaction between the students' algebraic abilities and the multiple choice items was overall good. Fisher (2007) states that if the person reliability value is 0.67 to 0.80, then item consistency has sufficient criteria.

The Separation value in the table aims to determine the grouping of respondents and items. The greater the Separation value, the better the quality of the instrument for all respondents and items, because it can identify groups of respondents and items (Sari et al., 2021). In the measure person table, only around 1 means that there is only one identified group and it varies, while measure item Separation values are greater than 2, meaning that the items identified are more than one group.

4. CONCLUSION

The results of the person analysis stated that the basic algebra ability of the students as a whole was greater than the difficulty level of the questions. The basic Algebra ability possessed by all students are higher than the difficulty level of all the algebra questions tested. This shows that the consistency of students' answers in solving multiple choice questions on algebraic material according to the level of difficulty is strong or good, but the quality of the items used in collecting data on students' algebraic abilities is of moderate quality.

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