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QUALITY OF STUDENTS' MATHEMATICAL CONCEPT UNDERSTANDING INSTRUMENTS USING THE RASCH MODEL

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Abstract: This study aims to describe the quality of the questions on students' ability to understand mathematical concepts from the aspects of validity, reliability, level of difficulty of the questions, and the distinguishing power of the items. The data obtained is the end of semester assessment data for class XII with the documentation method in the form of 15 multiple choice questions and tested on 29 vocational students. Data were analyzed using a modern modeling approach, namely the Rasch Model using Ministep software. The results of the analysis obtained in this study are the quality of questions from the validity aspect obtained 13 questions in the valid category and 2 questions in the invalid category. The Cronbach alpha (KR-20) reliability value is 0.57 (medium) with a person reliability value of 0.59 (weak) and a question item reliability value of 0.84 (good). The average difficulty index of the items shows that there are four categories of item difficulty, namely 3 very easy questions, 3 easy questions, 7 difficult questions, and 2 very difficult questions. The differentiating power of the items using Rasch modeling obtained a differentiating power value of 3.34 and 1.76 in the sufficient category, which means that the questions made are sufficient to distinguish students who are able to answer questions and students who have low ability to answer questions. Based on this, the research instrument developed can be used to measure students' mathematical concept understanding ability.

Keywords: Understanding of Mathematical Concepts, Rasch Model, Ministep, Item Response Theory

Introduction

Mathematics is defined as a field of science that studies patterns of structure, change, and space. Mathematics is the study of abstract structures associated with axioms using symbolic logic and notation (Hariwijaya, 2009). Studying mathematics makes students understand a hierarchical subject where understanding of a concept is built cumulatively starting from defining an object that only involves various counting operations to the stage of analyzing concepts (Souza de Cursi, 2015). This is in accordance with the educational objectives that are based on 21st century competencies that require students to have one of the skills to face the industrial revolution, namely mathematical concept understanding skills (Baiduri, 2019; Collins & Halverson, 2010; Subekt et al., 2017). Understanding mathematical concepts is the competence in explaining the relationship between concepts by using concepts and algorithms flexibly, accurately, efficiently, and precisely in problem solving. Understanding mathematical concepts allows a person to solve problems better (Griffin, 2004; Sztajn et al., 2012), can develop ideas (Achdiyat & Lestari, 2016), have rules in conceptualization (Holidun et al., 2018), so that understanding of mathematical concepts is well developed (Kleden et al., 2018).

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Understanding concepts is more important than just memorizing. (Hamalik, 2008) argues that concept understanding is mastering something with a mind that contains general categories or characteristics so that it is more embedded in students. Students will find it easier to solve math problems if they first understand mathematical concepts. Mastery of many concepts allows one to solve problems better, because solving problems requires rules based on the concepts possessed (Fajar et al., 2019; Izzati et al., 2021).

Understanding mathematical concepts in learning includes the ability to absorb material, remember mathematical formulas and concepts, and apply them to simple cases or to similar cases, estimate the truth of a statement, and apply formulas and theorems in problem solving (Sumarmo, 2014). In line with this, Radiusman (2020) revealed that understanding concepts consists of understanding mathematical concepts, explaining the relationship between concepts, applying concepts that can be used to solve problems. Understanding of mathematical concepts can help students connect concepts freely and appropriately to solve problems. Proper understanding of concepts must be given since students are in elementary school because understanding of concepts is needed in understanding the concept of knowledge at the next level (Karim, 2011).

However, in reality students still have difficulty in solving math problems due to difficulties in understanding concepts and relating to facts, this shows that the mathematical concepts taught are still poorly understood and need to be improved (Alamsyah, 2017). Research conducted by Indah & Hidayati (2021) states that the average ability to understand mathematical concepts of students is 58% of the ideal score and is in the insufficient category, students are accustomed to memorizing a concept without knowing how the formation of the concept takes place so that if given a different problem as exemplified by the teacher, students have difficulty solving it due to lack of understanding of mathematical concepts. In addition, research conducted by Sudirman et al (2020) states that the level of understanding of mathematical concepts possessed by students varies according to their characteristics and is supported by Yuliani et al (2018) who explain that students tend to find it difficult to convert a problem into a mathematical sentence or mathematical model, do not understand what is asked in the problem, are less able to classify objects known in the problem, have difficulty applying the concept of solving algorithmically and choosing operations in solving algebraic forms.

The difficulties experienced by students in the ability to understand mathematical concepts will affect the decline in student learning outcomes (Novitasari & Leonard, 2017; Yurliananda & Yuza, 2022). This is because in solving math problems there is an involvement of understanding mathematical concepts so that students can solve the problems given by using these concepts. If students are wrong in answering questions, it will affect the acquisition of learning outcomes. According to Skemp (1976) understanding of mathematical concepts can be built by instrumental understanding and rational understanding that can be developed by teachers. Instrumental understanding can be interpreted as an understanding of concepts that are mutually exclusive and only formulas are used in performing simple calculations. Meanwhile, rational understanding includes a scheme or structure that can be used in solving broader problems.

Mathematical concept understanding has several indicators according to Shadiq (2009), namely (1) restating a concept that has been learned; (2) classifying objects based on whether or not the requirements that make up the concept are met; (3) applying concepts algorithmically; (4) providing examples and non-examples of concepts that have been learned; (5) presenting concepts in various forms of mathematical representations; (6) linking various mathematical concepts; and (7) developing the necessary conditions of a concept. Based on these indicators, an instrument can be developed using practice questions to determine the extent of students' mathematical concept understanding abilities so that teachers have a reference in improving these abilities.

Based on an interview conducted with one of the mathematics teachers, it was stated that to make an assessment instrument requires a lot of time and accuracy. The availability of mathematical concept understanding ability assessment instruments is still difficult to develop (Sari, 2020). Therefore, this research is focused on developing a final assessment instrument for students' mathematical concept understanding ability. This research is limited to the suitability of mathematical understanding assessment instruments using the Rasch model. The Rasch model is a modern test analysis technique that can overcome various limitations of classical theory (Widhiarso, 2016). This model is part of item response theory (Thissen et al., 2001). With the Rasch model, educational assessment and evaluation will be more objective and the accuracy between the test developed and the subject being measured can be revealed. Test takers with high ability should have a greater chance of answering a question correctly than other students. Conversely, students with low ability have less chance of answering correctly a question that has higher difficulty (Sumintono & Widhiarso, 2015). Testing with the Rasch model in this research includes validity, reliability, item differentiation, and item difficulty.

Methods

Research Design

This study used a one shot case study method or commonly referred to as a one group post-test only design (Johnson & Christensen, 2014). This design only involves one group or one event at a certain period of time (Creswell, 2016). This study was conducted on one group of students by giving a mathematical concept understanding test instrument.

Population and Sample

The population in this study was all XII grade students at one of the vocational high schools in Bandung consisting of 6 classes. The sample was selected using purposive sampling technique based on criteria from the math class teacher. The criteria used are classes that have done the final exam on one of the math materials and classes consisting of students who have diverse concept understanding abilities, so the sample in this study is vocational XII class totaling 29 students.

Research Instruments

This study used mathematical concept understanding instruments in the form of multiple choice questions as many as 15 items. The cognitive dimension of the items consists of applying (C3) and analyzing (C4) levels. Indicators of understanding of mathematical concepts are associated with one of the XII grade mathematics materials, namely limits and derivatives. Analysis of students' mathematical concept understanding ability using Rasch model with the help of Ministep software version 5.3.3.1 (Sumintono & Widhiarso, 2014). Ministep software is a computational tool in the Rasch model to analyze scores generated from test instruments with the aim of knowing MNSQ Outfit, ZSTD Outfit, Point Measure Correlation, Item reliability and Cronbach's Alpha (Azizah & Wahyuningsih, 2020).

Analysis of Research Instruments

Analysis of research instruments aims to determine the validity, reliability, difficulty level, and differentiation of the items. The validity test is conducted to measure the extent to which the accuracy and accuracy of an instrument in measuring what should be measured (Ghozali, 2006). The mathematical concept understanding instrument has construct validity which is analyzed using the Outfit MNSQ value with the following criteria (Boone et al., 2014):

Table 1: *Research Instrument Validity Test Criteria*

Criteria	Category
$0.50 \leq x \leq 1.50$	Valid
$x < 0.50$ and $x > 1.50$	Invalid

In addition, the instrument reliability test shows how consistent the instrument is to measure students' mathematical concept understanding ability with the following criteria (Gliem & Gliem, 2003).

Table 2: Research Instrument Reliability Test Criteria

Reliability Coefficient	Category
$0.90 \leq x < 1.00$	Very High
$0.70 \leq x < 0.90$	High
$0.40 \leq x < 0.70$	Moderate
$0.20 \leq x < 0.40$	Low
$x < 0.20$	Very Low

Instrument reliability categories based on respondents and items can be seen in the table below:

Table 3: Respondent and Item Reliability Test Criteria

Reliability Coefficient	Category
$x > 0.94$	Excellent
$0.91 < x \leq 0.94$	Very Good

$0.81 < x \leq 0.91$	Good
$0.67 < x \leq 0.81$	Fair
$x \leq 0.67$	Weak

Item discrimination power is an indicator of alignment or consistency between item functions and overall scale functions (Azwar, 2011). Testing the discrimination power of items or the correlation value of item scores is seen in the measure correlation value with the following criteria (Smiley, 2015):

Table 3: Research Instrument Differential Test Criteria

Differential Coefficient	Category
$x \geq 0.70$	Excellent
$0.40 \leq x < 0.70$	Good
$0.20 \leq x < 0.40$	Fair
$x < 0.20$	Poor

Results and Discussion

The mathematical concept understanding ability assessment instrument used is an elaboration of five indicators, namely: (1) students can restate a concept that has been learned; (2) students can classify objects based on whether or not the requirements that make up the concept are met; (3) students can present concepts in the form of mathematical representations; (4) students can relate mathematical concepts; and (5) students can develop the necessary conditions of a concept. Indicators of understanding of mathematical concepts are then translated into indicators of questions that are adapted to the limit and derivative material in class XII. The indicators used are presented in table 4.

1. Table 4: Indicator of Mathematical Concept Understanding Ability Test

Indicator of Mathematical Concept Understanding	Problem Indicator	Cognitive Domain	Item Number
Students can restate a concept that has been learned	Use properties of a function to find the limit of a function	C3	1,2

Students can classify objects based on whether or not the requirements that make up the concept are met	Using the concept of limit in solving problems related to the limit of algebraic functions (polynomials)	C3	7,8,9
	Determine the derivative of a function by using derivative rules	C3	11,12
Students can relate math concepts	Determine the limit of a function using value approximation, factoring, or by function substitution	C3	4,10
	Determine the derivative of a function by using the concept of limit function	C4	14
Students can present concepts into a mathematical representative form	Finding the limit of an algebraic function	C4	3,5,6
Students can develop the necessary condition of a concept	Determine the derivative of a function by using derivative rules	C4	13,15

Research Instrument Validity Test Results

Using the Ministep application, the results of the instrument validity test can be seen in the figure below.

TABLE 13.1 Data Obs-Tanpa Kunjaw.xlsx ZOU953WS.TXT Feb 25 2023 20: 9
INPUT: 29 PERSON 15 ITEM REPORTED: 29 PERSON 15 ITEM 2 CATS MINISTEP 5.3.3.1

PERSON: REAL SEP.: 1.07 REL.: .53 ... ITEM: REAL SEP.: 2.26 REL.: .84

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
15	5	29	1.99	.52	1.14	.55	1.38	.79	.10	.28	82.8	82.7	P15
6	6	29	1.74	.48	1.14	.60	2.96	2.87	.00	.30	79.3	79.3	P6
10	11	29	.77	.41	.80	-1.37	.71	-1.13	.57	.37	82.8	68.4	P10
7	12	29	.60	.41	.82	-1.27	.84	-.63	.54	.38	79.3	67.1	P7
12	12	29	.60	.41	.95	-.28	.89	-.39	.44	.38	72.4	67.1	P12
11	13	29	.43	.41	1.03	.25	.97	-.08	.38	.39	65.5	66.6	P11
14	13	29	.43	.41	.96	-.26	.89	-.47	.45	.39	65.5	66.6	P14
4	15	29	.11	.41	1.53	3.24	1.88	3.52	-.15	.40	41.4	66.9	P4
8	15	29	.11	.41	.96	-.23	.96	-.14	.44	.40	75.9	66.9	P8
13	16	29	-.06	.41	1.02	.21	.94	-.22	.41	.41	58.6	67.8	P13
9	18	29	-.40	.42	.64	-2.32	.56	-2.16	.75	.41	89.7	70.5	P9
3	20	29	-.77	.44	.91	-.40	.85	-.44	.50	.41	79.3	74.5	P3
2	22	29	-1.19	.47	.97	-.02	.83	-.35	.45	.40	75.9	78.7	P2
1	25	29	-2.00	.58	.98	.07	1.10	.37	.32	.35	89.7	86.7	P1
5	26	29	-2.37	.65	.92	-.02	.68	-.22	.40	.32	89.7	89.6	P5
MEAN	15.3	29.0	.00	.46	.99	-.08	1.10	.09			75.2	73.3	
P.SD	5.9	.0	1.17	.07	.19	1.17	.58	1.38			12.7	7.8	

Figure 1: Research Instrument Validity Test Results

The validity value of the instrument is shown in the Outfit MNSQ column of each item, if the value is $0.50 \leq Outfit\ MNSQ \leq 1.50$ then the question item is declared valid and vice versa if the $Outfit\ MNSQ < 0.50$ and $Outfit\ MNSQ > 1.50$ then the question item is declared invalid. Outfit MNSQ is useful for seeing the fit of the data with the model used. The expected mean square value is 1 (one). If the mean-square value of infit is greater than one, the variation of the instrument is more than predicted by the Rasch model. If the infit value is less than 1, then the variation in the instrument is less when compared to the predictions made by the Rasch model. In Figure 1, it can be seen that there are two items that have Outfit MNSQ values above 1.50, namely items 4 and 6, this means that the two items are in the invalid category. Meanwhile, there are 13 items that have Outfit MNSQ values in the range of 0.50 and 1.50, which means that these items are in the valid category.

Table 5. Summary of Statistical Results

	Description	Value
Outfit MNSQ	Person	1.10
	Item	1.10
Outfit ZSTD	Person	0.09
	Item	0.09

Furthermore, table 5 obtained an Outfit Z Standardized (Outfit ZSTD) value of 0.09 for person and item. This value is between the range $-2.0 < ZSTD < 2.0$ which means that the data has a rational value possibility. This means that overall the items or items are in accordance with the Rasch model and can be used as a test instrument for the ability to understand mathematical concepts on limit and derivative material.

Reliability Test Results of Research Instruments

The reliability test is used to measure the extent to which a test remains consistent after being used or applied repeatedly to subjects or students. In this study, the reliability value is presented as seen from the items and respondents.

```
TABLE 3.1 Data Obs-Tanpa Kunjaw.xlsx            ZOU953WS.TXT  Feb 25 2023 20: 9
INPUT: 29 PERSON  15 ITEM  REPORTED: 29 PERSON  15 ITEM  2 CATS MINISTEP 5.3.3.1
--------------------------------------------------------------------------------

     SUMMARY OF 29 MEASURED PERSON
-------------------------------------------------------------------------------
|          TOTAL                         MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE    S.E.      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN       7.9      15.0         .15     .62       .99   -.07   1.10    .09 |
|  SEM        .5        .0         .18     .01       .06    .20    .16    .20 |
| P.SD       2.6        .0         .97     .06       .29   1.08    .83   1.05 |
| S.SD       2.6        .0         .99     .06       .30   1.10    .85   1.06 |
| MAX.      12.0      15.0        1.73     .83      1.65   1.82   4.88   2.34 |
| MIN.       2.0      15.0       -2.33     .58       .49  -1.83    .32  -1.30 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .66 TRUE SD     .71  SEPARATION  1.07  PERSON RELIABILITY  .53 |
|MODEL RMSE    .62 TRUE SD     .75  SEPARATION  1.19  PERSON RELIABILITY  .59 |
| S.E. OF PERSON MEAN = .18                                                   |
-------------------------------------------------------------------------------
PERSON RAW SCORE-TO-MEASURE CORRELATION = 1.00
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .57  SEM = 1.69
STANDARDIZED (50 ITEM) RELIABILITY = .83
```

Figure 2: Reliability Test Results Based on Respondents

Figure 2 shows that the Cronbach alpha (KR-20) value is 0.57, this means that the overall instrument reliability value is in the medium category. Meanwhile, the reliability value based on respondents from the RMSE model is 0.59, this means that the reliability value of the instrument when viewed from students is in the weak category.

```
     SUMMARY OF 15 MEASURED ITEM
-------------------------------------------------------------------------------
|          TOTAL                         MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE    S.E.      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN      15.3      29.0         .00     .46       .99   -.08   1.10    .09 |
|  SEM       1.6        .0         .31     .02       .05    .31    .16    .37 |
| P.SD       5.9        .0        1.17     .07       .19   1.17    .58   1.38 |
| S.SD       6.1        .0        1.21     .07       .20   1.21    .60   1.43 |
| MAX.      26.0      29.0        1.99     .65      1.53   3.24   2.96   3.52 |
| MIN.       5.0      29.0       -2.37     .41       .64  -2.32    .56  -2.16 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .47 TRUE SD    1.07  SEPARATION  2.26  ITEM   RELIABILITY  .84 |
|MODEL RMSE    .46 TRUE SD    1.07  SEPARATION  2.33  ITEM   RELIABILITY  .84 |
| S.E. OF ITEM MEAN = .31                                                     |
-------------------------------------------------------------------------------
ITEM RAW SCORE-TO-MEASURE CORRELATION = -1.00
Global statistics: please see Table 44.
UMEAN=.0000 USCALE=1.0000
```

Figure 3: Reliability Test Results Based on Item

Meanwhile, the results of the instrument reliability test based on items can be seen in the RMSE model reliability value of 0.84, this means that the research instrument has item reliability in the high/good category.

Problem Difficulty Test Results

The test of the level of difficulty of the question can be seen from the distribution of item abilities presented in the Ministep application. The following are the results of the test of the level of difficulty of the questions which can be seen in Figure 4.

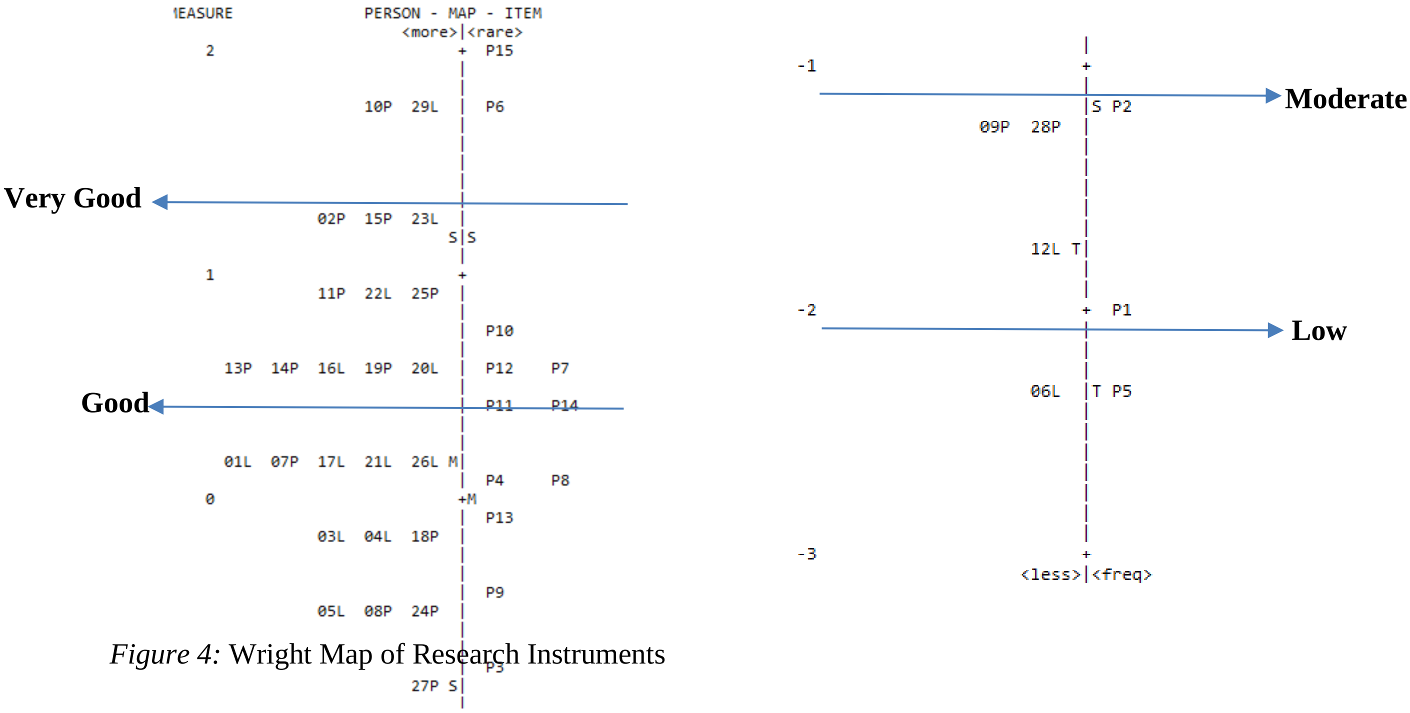

Figure 4: Wright Map of Research Instruments

In Figure 4, the distribution of students' abilities in answering each mathematical concept understanding question can be observed. The distribution of students' abilities is analyzed based on the logit measure value. The average logit value is set with 0.0 as the standard difficulty level of the question and the standard of student ability. Students 10P and 29L are the students who have the highest concept understanding ability with +1.70 logit value. This logit value is also shown by item P6 which means that item 6 is the most difficult item for students to answer. This item was answered correctly by 10 students with female gender and 29 students with male gender. However, there is still a question with high difficulty, namely item 15 with a value of +2.00 logit where no student can answer this question correctly. Meanwhile, student 06L is the student who has the lowest concept understanding ability with a logit value of -2.10 logit. This logit value is also shown by item P5 which means that item 5 is the easiest item for students to answer.

Problem item 6 and item 15 are problems that are difficult to answer by 24 students and 11 of them are above the value of 0.0 logit. Problem 6 and 15 are questions at the C4 (analyzing) cognitive level with problem indicators, namely finding the limit of an algebraic function and determining the derivative of the function using the derivative rules. This shows that students' mastery of mathematical concepts in the material of limit and derivative of algebraic functions is still lacking. So that in-depth learning and practice problems are needed so that students can get used to solving limit and derivative problems of algebraic functions properly.

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
15	5	29	1.99	.52	1.14	.55	1.38	.79	.10	.28	82.8	82.7	P15
6	6	29	1.74	.48	1.14	.60	2.96	2.87	.00	.30	79.3	79.3	P6
10	11	29	.77	.41	.80	-1.37	.71	-1.13	.57	.37	82.8	68.4	P10
7	12	29	.60	.41	.82	-1.27	.84	-.63	.54	.38	79.3	67.1	P7
12	12	29	.60	.41	.96	-.28	.89	-.39	.44	.38	72.4	67.1	P12
11	13	29	.43	.41	1.03	.25	.97	-.08	.38	.39	65.5	66.6	P11
14	13	29	.43	.41	.96	-.26	.89	-.47	.45	.39	65.5	66.6	P14
4	15	29	.11	.41	1.53	3.24	1.88	3.52	-.15	.40	41.4	66.9	P4
8	15	29	.11	.41	.96	-.23	.96	-.14	.44	.40	75.9	66.9	P8
13	16	29	-.06	.41	1.02	.21	.94	-.22	.41	.41	58.6	67.8	P13
9	18	29	-.40	.42	.64	-2.32	.56	-2.16	.75	.41	89.7	70.5	P9
3	20	29	-.77	.44	.91	-.40	.85	-.44	.50	.41	79.3	74.5	P3
2	22	29	-1.19	.47	.97	-.02	.83	-.35	.45	.40	75.9	78.7	P2
1	25	29	-2.00	.58	.98	.07	1.10	.37	.32	.35	89.7	86.7	P1
5	26	29	-2.37	.65	.92	-.02	.68	-.22	.40	.32	89.7	89.6	P5
MEAN	15.3	29.0	.00	.46	.99	-.08	1.10	.09			75.2	73.3	
P.SD	5.9	.0	1.17	.07	.19	1.17	.58	1.38			12.7	7.8	

Figure 5: Problem Difficulty Test Results

Figure 5 also shows the results of the overall question difficulty test which can be seen in the JMLE Measure column. There are two items with JMLE Measure above 1.00, namely items 6 and 15 which are in the very difficult category, this is in accordance with the wright map image previously described. There are 7 items with JMLE Measure in the range of 1.00 and 0.00, namely items 4, 7, 8, 10, 11, 12, and 14, which means that the question is in the difficult category. In addition, there are 3 items with JMLE Measure in the range of 0.00 and -1.00, namely items 3, 9, and 13 which means the level of difficulty of the easy category questions and there are 3 items with JMLE Measure below -1.00, namely items 1, 2, and 5 which means the level of difficulty of very easy category questions.

Item Differential Test Results

The results of the difference test in Rasch modeling are used for analysis at the individual ability level as a tool to distinguish the ability of students who are able to answer concept understanding questions and students who are unable to answer questions. In addition, it can also use a way to identify respondent groups based on the respondent separation index. The greater the item separation value, the better the quality of the instrument in terms of overall respondents and items, because it can identify respondent groups and item groups (Sumintono & Widhiarso, 2015). Another equation to find out the grouping more thoroughly is the strata equation (H) as follows:

$$H = \frac{[(4\ x\ Separation) + 1]}{3}$$

Based on this formula, it is known that the separation value of the items is 2.26, then the value of H = 3.34, so there are 3 groups of items, namely easy, difficult, and very difficult. Meanwhile, for respondents, the separation value is 1.19 with a value of H = 1.76 rounded to 2, indicating that the respondent group can be divided into two groups based on the respondent's separation value, namely students with sufficient concept understanding ability and students with poor concept understanding ability.

Analysis of the Appropriateness of Student Answers

The suitability of student answers can be seen in the Expected Score ICC graph on the Ministep Application. If the expected score ICC value cuts the gray standard line then the item is outside the confidence space, otherwise if the expected score ICC value does not cut the gray standard line then the item is still within the confidence limits (Risdianto et al., 2021). The following presents the results of the suitability of student answers.

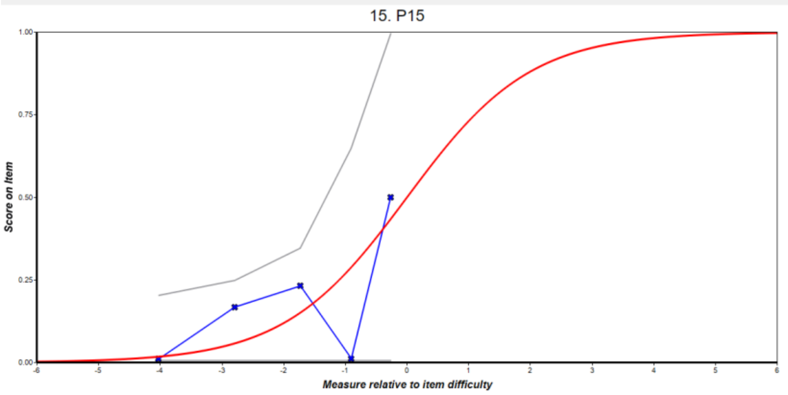

Figure 6: Appropriate Student Response

In the figure above, it can be seen that in question item number 15 or with code P15, students' answers are as expected, this is indicated by the blue line of the item that does not intersect with the standard line. There are 12 similar items, namely question items 1, 2, 3, 5, and 7-14, this means that these items show the suitability between the ability and the answers given by students.

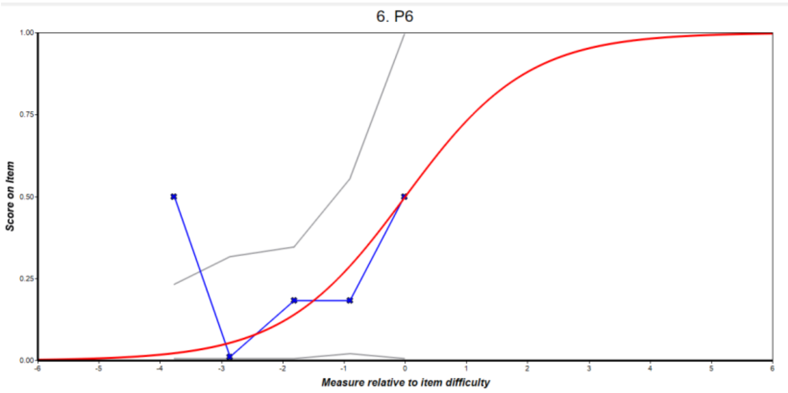

Figure 7: Inappropriate Student Response

Figure 7 shows item question 6 that does not match the expected student answers, this can be seen from the blue item line that intersects with the standard line. In addition, there is also a question item 4 that depicts the same graph, this means that the two questions do not match the description between students' abilities and answers.

Conclusions

The results showed that the quality of the items of mathematical concept understanding ability through Rasch Modeling was generally categorized as a question with good quality in terms of validity, reliability, difficulty level of the question, and item differentiation. The validity results show that the research instrument is in a good category with 13 items in the valid category and 2 items in the invalid category so that they can be repaired or replaced with new question items by paying attention to the question indicators and indicators of mathematical concept understanding ability. In addition, the reliability of the research instrument as a whole is obtained from the Cronbach alpha value of 0.57 with a moderate category. However, the reliability value when viewed from the respondent is 0.59 with a weak category and the reliability seen from the item is 0.84 with a high category. The average question difficulty index shows 2 items in the very difficult category, 7 items in the difficult category, 3 items in the easy category, and 3 items in the very easy category. The differentiation of items also shows that the research instrument can distinguish items into three groups, namely easy, difficult, and very difficult as well as the ability of students into two groups, namely sufficient concept understanding ability and poor concept understanding ability. This interpretation is based on the item separation index of 3.34 and 1.76, respectively. Based on this, the research instrument developed can be used to measure students' mathematical concept understanding ability. However, this study also has limitations in terms of the number of questions made and trials that were only conducted in one class. So, further research can be done by developing instruments with a wider scale.

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Declaration of Interest Statement

The authors declare that they have no conflict of interests.

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