ITEM ANALYSIS USING RASCH MODEL ON GEOMETRY FOR GRADE 1

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ABSTRACT

The purpose of this research is to analyse the problem associated with the geometry instructional materials for grade 1 students using the Rasch model. This is a descriptive research with a quantitative approach used to obtain information on the Wright map, item measure, and fit for instructors. Data were obtained by distributing a questionnaire containing 10 questions to 30 first-grade students in 192 Public Elementary Schools in Pekanbaru through Google form. The data collected were analysed using the Rasch model assisted by the Winstep or ministep version 3.73 application. The result showed that items 2 and 3 contained very difficult and easy questions, with a 0.30 indicating difficulty level. In conclusion, the test items used are valid and generally not difficult for students.

Keywords: Item Analysis; Introduction to Geometry; Rasch Model

INTRODUCTION

Mathematics is an exact science, which means it accepts absolute precision results and cannot be applied without any real proof, hence, it does not change but develops over time[1]. This implies mathematics education not only focuses on how to transfer its instructional material effectively but also on ways to develop valid and reliable test items. In the 2013 curriculum, teachers were required to be competent in developing test items capable of training students' thinking skills[2].

It is also necessary to conduct item analysis and evaluation activities carried out by teachers on students' responses to find out whether they have good quality[3].

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[1] Rizky Farah And B. Budiyono, "Pembelajaran Matematika Materi Geometri Di Sd Al Hikmah Surabaya," *Jurnal Penelitian Pendidikan Guru Sekolah Dasar* 6, no. 3 (2018): 254923.

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Item analysis needs to be conducted to evaluate the quality of each item as a whole in various aspects[4]. Analyzing test items is carried out to improve their quality and identify the shortcomings for learning enhancement[5]. The quality of items is very influential to students' final learning outcome and mastery of the formulated objectives[6]. Item analysis is conducted by collecting student responses to each test, to evaluate them to ensure they are of good quality before usage[7]. Item analysis can be conducted qualitatively and quantitatively by statistically examining the contents, form, and characteristics. The quantitative analysis includes validity, reliability, difficulty, discrimination, and interference[8]. The results can be used to determine students learning outcomes[4].

A valid test item means that it can be used to measure the proposed item. Conversely, a reliable item means it will produce the same result when examined several times on the same object irrespective of the variations[9]. The difficulty level of an item is an estimate of the skill level needed to pass its average requirement.

This research analyzed the test items of the introduction to geometry instructional materials using the Rasch model to obtain information on the Wright map, item measure, and fit. This model enabled the direct measurement of the validity and reliability based on the principle of probability[10]. Furthermore, the Rasch model was used to develop a data measurement model to determine the relationship between person ability and item difficulty. The advantages of this model are its ability to overcome problems related to test items, lower risk of missing data, and has met the criteria of objective measurements[11]. This model also has the ability to conduct predictions based on

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[4] Elviana, Elviana "Analisis Butir Soal Evaluasi Pembelajaran Pendidikan Agama Islam Menggunakan Program Anates, "*Jurnal Mudarrisuna: Media Kajian Pendidikan Agama Islam* 10, no.2 (2020): 58–74.

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[10] Sugiyono, "METLIT SUGIYONO.Pdf," 2015.

[11] Alan Tennant, Stephen P. McKenna, and Peter Hagell, "Application of Rasch Analysis in the Development and Application of Quality of Life Instruments," *Value in Health* 7, no. SUPPL. 1 (2004):

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systematic response patterns for missing data. It is calibrated in three directions, namely measurement scale, respondent, and item[12]. The use of the Rasch model is more effectively applied compared to the classic test theory[13]. In this research, the geometry test items, which analyzed, were developed by a mathematics teacher. Meanwhile, the test questions used were validated by other mathematics teachers.

RESEARCH METHODS

This is a descriptive research with the quantitative approach used to describe statistical events. The research instrument used was 10 items, which was analyzed in the introduction to geometry for first-grade students at Elementary School 192 in Pekanbaru. The sample consists of 30 students selected as respondents, and the data collected were analyzed using the Rasch modeling.
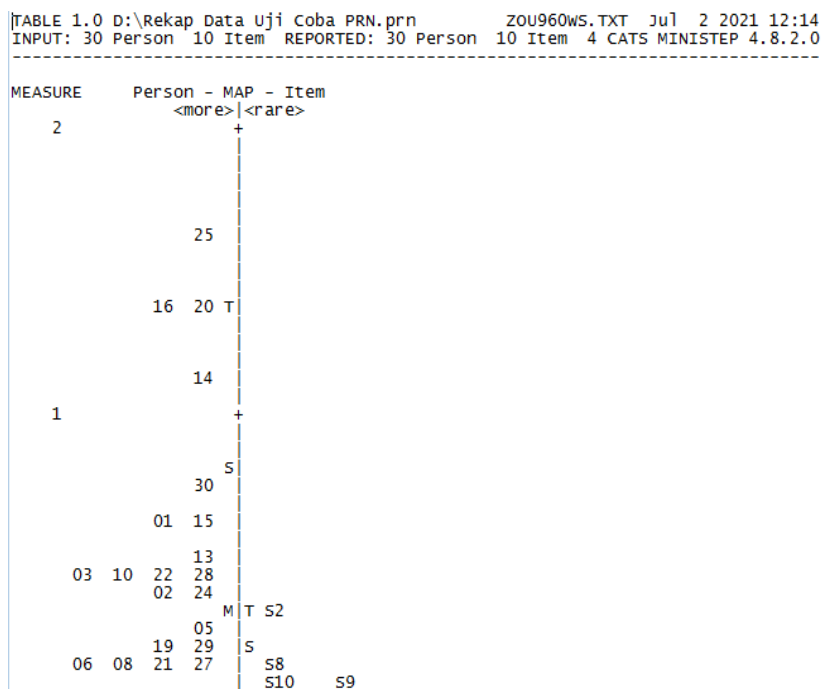
RESULT AND DISCUSSION

1.1 *Wright Map*


```
TABLE 1.0 D:\Rekap Data Uji Coba PRN.prn        ZOU960WS.TXT  Jul  2 2021 12:14
INPUT: 30 Person  10 Item  REPORTED: 30 Person  10 Item  4 CATS MINISTEP 4.8.2.0
--------------------------------------------------------------------------------

MEASURE      Person - MAP - Item
               <more>|<rare>
    2                +
                     |
                     |
                     |
                     |
           25        |
                     |
                     |
           16   20  T|
                     |
                     |
           14        |
                     |
    1                +
                     |
                     S|
           30        |
                     |
        01   15       |
                     |
             13       |
     03  10  22  28   |
         02  24       |
                     M|T S2
             05       |
         19  29      |S
     06  08  21  27   |  S8
                     |  S10      S9
```

Figure 1.
The Wright Map

S22–26, https://doi.org/10.1111/j.1524-4733.2004.7s106.x.

[12] Mohamad Ibnu et al., "Aplikasi Rasch Model: Pengembangan Instrumen Tes Untuk Mengukur Miskonsepsi Mahasiswa," *Prosiding Seminar Nasional Pendidikan FKIP* 2, no. 1 (2019): 205–10.

[13] Joshua A. Weller et al., "Development and Testing of an Abbreviated Numeracy Scale: A Rasch Analysis Approach," *Journal of Behavioral Decision Making* 26, no. 2 (2013): 198–212, https://doi.org/10.1002/bdm.1751.

In Figure 1, Wright's map depicts a test by placing items based on the difficulty level of the students' ability on the measurement scale. Wright's map was created with two histograms that are vertical in shape. The left side displays the distribution portion of student abilities, from the top being the most capable to the lowest, known as the least with 25 and 11 students. In contrast, the right side of the figure shows the easiest and most difficult items in items 2 and 3. Test questions included as the most difficult can be answered correctly by 14 students, 6, 8, 21, and 27 are opposite and in item 8. This means that the difficulty level of students' ability items is comparable, hence, the probability of them answering the questions is about 50%. Question 3 can be answered by 11 students, while 23 can provide correct or incorrect answers to item 12. Based on the picture above, it can be interpreted that the test questions are generally not too difficult for students.

1.2 Item Fit


```
TABLE 10.1 D:\Rekap Data Uji Coba PRN.prn        ZOU960WS.TXT  Jul  2 2021 12:14
INPUT: 30 Person  10 Item  REPORTED: 30 Person  10 Item  4 CATS MINISTEP 4.8.2.0
------------------------------------------------------------------------------------
Person: REAL SEP.: 1.13  REL.: .56 ... Item: REAL SEP.: .00  REL.: .00

          Item STATISTICS:  MISFIT ORDER
------------------------------------------------------------------------------------
|ENTRY   TOTAL  TOTAL            MODEL|   INFIT  |  OUTFIT  |PTMEASUR-AL|EXACT MATCH|    |
|NUMBER  SCORE  COUNT  MEASURE   S.E. |MNSQ  ZSTD|MNSQ  ZSTD|CORR.  EXP.| OBS%  EXP%| Item|
|---------------------------------------+----------+----------+-----------+-----------+-----|
|    6     57     30    -.09      .18|1.28  1.41|1.14   .92|A .41   .42| 30.0  30.0| S6  |
|    7     55     30    -.03      .17|1.13  1.72|1.09   .2|B .41   .43| 30.0  30.6| S7  |
|    8     49     30     .15      .17|1.10  1.59|1.06   .4|C .44   .45| 30.0  31.3| S8  |
|    2     44     30     .30      .17|1.09  1.51|1.02   .8|D .42   .47| 26.7  30.0| S2  |
|    5     54     30     .00      .17|1.03  1.22| .97  -.4|E .48   .44| 30.0  30.8| S5  |
|    1     55     30    -.03      .17| .98  -.03|1.00   .8|e .43   .43| 26.7  30.6| S1  |
|   10     51     30     .09      .17|1.00   .05|1.00   .0|d .37   .45| 23.3  31.4| S10 |
|    9     52     30     .06      .17| .89  -.54| .86  -.3|c .47   .44| 23.3  30.6| S9  |
|    4     58     30    -.12      .18| .82  -.95| .87  -.1|b .42   .42| 40.0  30.1| S4  |
|    3     64     30    -.32      .19| .68 -1.57| .63 -1.7|a .52   .39| 46.7  31.3| S3  |
|---------------------------------------+----------+----------+-----------+-----------+-----|
| MEAN   53.9   30.0     .00      .18|1.00   .0| .97   .1|          | 30.7  30.7|    |
| P.SD    5.1    .0      .16      .00| .16   .8| .14   .5|          |  7.0   .5|    |
------------------------------------------------------------------------------------
```

Figure 2.
Item Suitability Analysis

In Figure 2, the Item fit is used to describe whether an item under test is functioning normally as a measuring tool. Outfit MNSQ and infit ZSTD are used to determine item match rate. An item can be said to be fit assuming the score from MNSQ $0.5 < MNSQ < 1.5$, and ZSTD score $-2.0 < ZSTD < +2.0$.

1.3 Item Measure

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TABLE 13.1 D:\Rekap Data Uji Coba PRN.prn        ZOU960WS.TXT  Jul  2 2021 12:14
INPUT: 30 Person  10 Item  REPORTED: 30 Person  10 Item  4 CATS MINISTEP 4.8.2.0
--------------------------------------------------------------------------------
Person: REAL SEP.: 1.13  REL.: .56 ... Item: REAL SEP.: .00  REL.: .00

         Item STATISTICS:  MEASURE ORDER

--------------------------------------------------------------------------------
|ENTRY  TOTAL  TOTAL           MODEL|  INFIT  | OUTFIT  |PTMEASUR-AL|EXACT MATCH|      |
|NUMBER SCORE  COUNT MEASURE   S.E. |MNSQ ZSTD|MNSQ ZSTD|CORR.  EXP.| OBS%  EXP%| Item |
|-----------------------------------+---------+---------+-----------+-----------+------|
|   2    44     30    .30      .17|1.09  .51|1.02  .18| .42   .47| 26.7  30.0| S2   |
|   8    49     30    .15      .17|1.10  .59|1.06  .34| .44   .45| 30.0  31.3| S8   |
|  10    51     30    .09      .17|1.00  .05|1.00  .10| .37   .45| 23.3  31.4| S10  |
|   9    52     30    .06      .17| .89 -.54| .86 -.53| .47   .44| 23.3  30.6| S9   |
|   5    54     30    .00      .17|1.03  .22| .97 -.04| .48   .44| 30.0  30.8| S5   |
|   1    55     30   -.03      .17| .98 -.03|1.00  .08| .43   .43| 26.7  30.6| S1   |
|   7    55     30   -.03      .17|1.13  .72|1.09  .42| .41   .43| 30.0  30.6| S7   |
|   6    57     30   -.09      .18|1.28 1.41|1.14  .62| .41   .42| 30.0  30.0| S6   |
|   4    58     30   -.12      .18| .82 -.95| .87 -.41| .42   .42| 40.0  30.1| S4   |
|   3    64     30   -.32      .19| .68 -1.57| .63 -1.27| .52   .39| 46.7  31.3| S3   |
|-----------------------------------+---------+---------+-----------+-----------+------|
| MEAN  53.9   30.0   .00      .18|1.00  .0| .97 -.1|           | 30.7  30.7|      |
| P.SD   5.1    .0    .16      .00| .16  .8| .14  .5|           |  7.0   .5|      |
--------------------------------------------------------------------------------
```

Figure 3.
Item Measure

In Figure 3, the item measure was used to explain the level of need with the number section sequentially arranged by difficulty level. From the result of the analysis, it can be seen that items 2 and 3 are the most difficult and easiest, respectively.
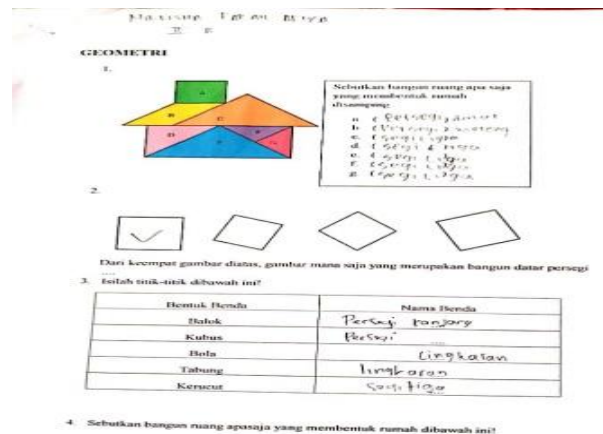

Figure 4.
Question Number 2 which is Approved as the Most Difficult Question

Figure 4 presents item 2, which is the most difficult based on information in Figure 3, which shows that approximately 70% of the respondents provided incorrect answers.
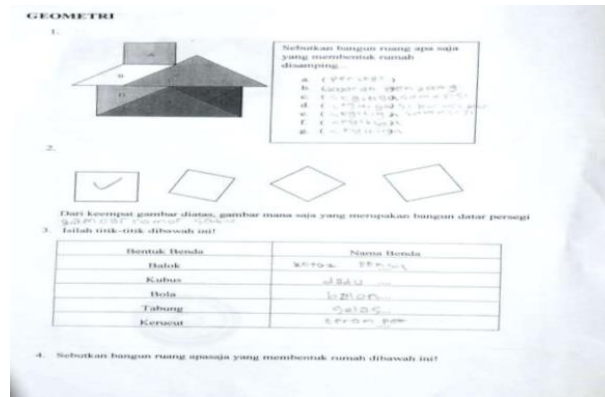
Figure 5.
Question Number 3 that was Approved the Easiest

Figure 5 presents item 3, the easiest based on information in Figure 3, where approximately 607% of the respondents provided correct answers.
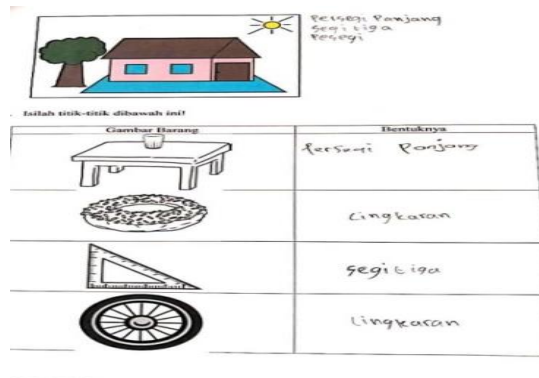

Figure 6.
Item 5

Figure 6 illustrates item 5, which has moderate difficulty based on information in Figure 3, where about 48% of the respondents provided correct answers.

CONCLUSION

In conclusion, this research analysed the items in the geometry introduction material using Rasch modelling to determine information related to the Wright map, measure item, and fit item. The subjects were 30 first-grade students of 192 Pekanbaru State Elementary Schools asked to provide answers to 10 items. The result showed that items 2 and 3 are the most difficult and easiest, with a size value of 0,30. Therefore, it can be concluded that all items are valid, and the mathematics learning process is generally not difficult.

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Melvi Lesma Alim	iD	-

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