

# Using the Rasch Model to Measure Students' Argumentative Ability in the Context of Socioscientific Issues About the Covid-19 Pandemic

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## Using the Rasch Model to Measure Students' Argumentative Ability in the Context of Socioscientific Issues About the Covid-19 Pandemic

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### Abstrack

Argumentation plays an essential role in developing a critical thinking and understanding or interpreting a central idea of the existing problem. In addition, students need arguments to strengthen understanding and knowledge in the learning process. Socioscientific Issues is a combination of social issues involving moral and ethical components and their relevance to science. This study aims to determine the argumentation ability of junior high school students in the context of socioscientific issues with the topic of the Covid-19 Pandemic. The research method used is descriptive research with careful decision-making and description of an educational phenomenon. The subjects of this study were 133 students, consisting of grades 9 in several junior high schools in Abab District, Penukal Abab Lematang Ilir Regency. The technique of collecting research data employs a test with a total of three essay questions. Data from the study were analyzed using the Rasch model. The result showed that the argumentation skills of junior high school students were 57,29 out of 100 logits. This result indicates that, on average, students can put forward arguments by providing reasons that support their arguments.

**Keywords:** Rasch model, Argumentation, Socioscientific Issues, Pandemic Covid 19

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## INTRODUCTION

Natural sciences must be taught as early as possible accompanied by the provision of students' ability to argue. Argumentation is the main point in underpinning students to produce evidence, test, evaluate theories and communicate (Erduran et al., 2005). There are three reasons for the importance of growing argumentation in learning, namely 1) scientists use argumentation to enhance their development and scientific knowledge; 2) the community uses arguments as materials for scientific debate, and 3) students need arguments to strengthen understanding and knowledge in the learning process (Simon et al., 2006). One effort to involve students in scientific arguments is by using socioscientific issues (SSI) (Chin et al., 2016).

Research on argumentation in the SSI context has previously been carried out. This can be referred to from a content analysis study conducted by (Tekin et al., 2016). They analyzed the content of SSI-related articles published in five science education journals, namely Science Education (SE), Journal of Research in Science Teaching (JRST), Science and Education (S&E), International Journal of Science Education (IJSE) and Research in Science Education (RSE) in the period 2004-2015. They found 122 articles about SSI, and the most discussed topic (19.55%) was argumentation. In addition, they also found that the sample that was mostly involved in research related to SSI was junior and senior high school students (50% of the 122 articles analyzed). More specifically, research related to argumentation involves mostly eighth graders (Erduran et al., 2015).

Although many studies on SSI have looked at how students engage with certain problems, few have compared the reasons used when faced with different SSI contexts. Students' personal knowledge and experiences contribute differently among SSI topics (Christenson et al., 2012). The consumption problem reflects more consideration of personal experience than any other problem.

Another study by Aleixo et al. (2021) revealed that when faced with three different topics regarding sustainable development: grocery shopping, global warming, and waste disposal, students prioritized aspects of the problem differently. Environmental reasons ranked highest for waste disposal issues, and economic ones took priority in grocery

shopping issues. Other studies have also revealed that there are differences in students' approaches to arguing in the context of SSI depending on the topics presented (Cian, 2020), where Cian presents two different topics, namely environmental and genetics.

From a number of studies that have been discussed, it can be concluded that students' arguments in the SSI context depend on the topic. So far no SSI research has been found on the topic of the Covid-19 Pandemic. Even though, as we know, a pandemic is global in nature, it also includes scientific and social aspects at the same time. The topic of SSI so far has only been limited to popular issues such as global warming, environmental pollution, habituation of the population in environmental sanitation. The research space on the topic of Covid 19 can be discussed, namely hygiene in society, the importance of personal hygiene in raising livestock and pets.

## METHODS

The research method used is descriptive research. Descriptive research is a type of quantitative research that involves making a careful description of an educational phenomenon (Schratz, 2020). The subjects of this study were 133 students consisting of grade 9 in four public junior high schools and two private junior high schools in Abab District, Penukal Abab Lematang Ilir Regency. This research was conducted in the odd semester of the 2021/2022 Academic Year.

Data collection was carried out by giving tests to measure students' argumentation abilities in the SSI context with the topic of the Covid-19 Pandemic. The research instrument used in this study was a test item in the form of a description consisting of three items. The instrument was developed by researchers and has been validated. The first question tested students' opinions regarding the Covid-19 vaccination. Students are given a narrative about the beginning of the Covid-19 pandemic and its spread throughout the world, then students are given two narratives regarding opinions that agree with vaccination for children aged 6-11 years and opinions that do not agree with reasons. Students are asked to answer and provide their arguments against the statements given. The schematization of this study can be seen in Figure 1 which shows the research syntax.

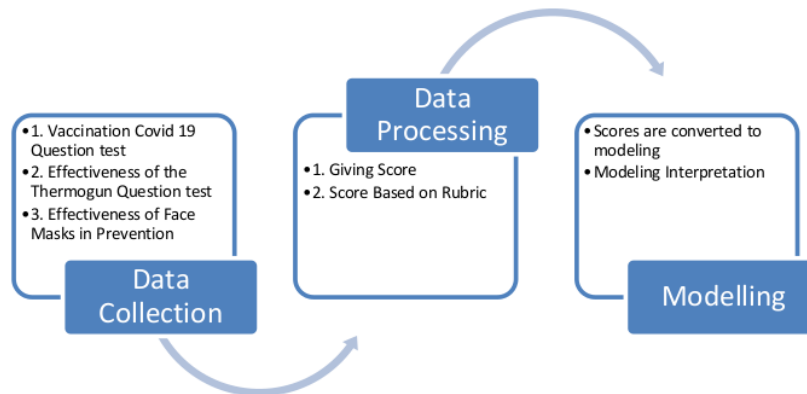


Figure 1. Research Methods Scheme

The second question discusses the effectiveness of the thermogun which can prevent the spread of the corona virus. The first opinion explains that the thermogun is dangerous and can cause nerve damage when directed at the forehead. Another opinion explains that a thermogun is not needed because if someone has a fever, of course he will not travel. Students are asked to choose and give their arguments against the statements given.

The third question discusses the effectiveness of masks as a way to prevent the spread of the corona virus. The narrative in the third problem tells about the results of a study which concluded that the chances of contracting the corona virus are smaller if we wear masks. The first opinion states that the use of masks is important because some people who are infected with Covid-19 do not show symptoms, but can transmit the virus to those around them. The second opinion considers the use of masks **2**n actually cause respiratory problems. Students are asked to choose and provide arguments against the statements given.

Statements will be scored according to the level in each aspect answered, along with the scoring rubric presented in table 1.

Table 1. Student Argumentation scoring rubric

| Sub Skills  | Average Score |
|---|---------------|
| There are only claims, no data  | 1             |
| Arguments based on justification (data disclosed)   | 2             |
| Anticipated arguments with counter-arguments (opposite arguments)                         | 3             |
| Arguments that contain claims, counter-arguments, and rebuttals to the counter-arguments. | 4             |

## RESULTS AND DISCUSSION

Before carrying out further analysis, the first thing that must be done in an analysis using Rasch is to ensure that the research data obtained are in accordance with the expected model. Figure 4.1 displays the summary statistics of 133 respondents, of which 17 received extreme scores (15 maximum scores, 2 minimum scores). The first important parameter to pay attention to is related to person reliability. The reliability of the person obtained is 0.62. This reliability is not high, but acceptable. Person fit can be seen from the infit mean square (infit mnsq) and outfit mean square (outfit mnsq), whose values are 0.94 and 0.99 respectively. Both value **4** are close to 1 which is the expected value in the Rasch model. Thus, the standard value of  $z$  is close to or equal to

4 zero (infit z 4 -0.1 ; outfit z = 0.0). The distribution of scores for persons (infit Z SD = 1.0; outfit 4 SD = 1.0) indicates that most estimates of person ability will change fit statistics well within the acceptable -2 to +2

range conventional. The resulting indices show that the data is in accordance with the expected model, so that it can be analyzed further to get an estimate of students' ability to argue.

13 SUMMARY OF 116 MEASURED (NON-EXTREME) PERSON

|                            | TOTAL SCORE | COUNT   | MEASURE | MODEL S.E. | INFIT |                    | OUTFIT |      |
|----------------------------|-------------|---------|---------|------------|-------|--------------------|--------|------|
|                            |             |         |         |            | MNSQ  | ZSTD               | MNSQ   | ZSTD |
| MEAN                       | 7.7         | 3.0     | 52.76   | 10.79      | .94   | -.1                | .99    | .0   |
| P.SD                       | 2.2         | .0      | 20.02   | 1.58       | .77   | 1.0                | .85    | 1.0  |
| S.SD                       | 2.2         | .0      | 20.11   | 1.58       | .77   | 1.0                | .85    | 1.0  |
| MAX.                       | 11.0        | 3.0     | 83.50   | 13.51      | 3.83  | 2.5                | 3.73   | 2.5  |
| MIN.                       | 4.0         | 3.0     | 16.98   | 9.46       | .06   | -2.1               | .06    | -2.1 |
| -----                      |             |         |         |            |       |                    |        |      |
| REAL RMSE                  | 12.27       | TRUE SD | 15.82   | SEPARATION | 1.29  | PERSON RELIABILITY |        | .62  |
| MODEL RMSE                 | 10.91       | TRUE SD | 16.79   | SEPARATION | 1.54  | PERSON RELIABILITY |        | .70  |
| S.E. OF PERSON MEAN = 1.87 |             |         |         |            |       |                    |        |      |
| -----                      |             |         |         |            |       |                    |        |      |
| MAXIMUM EXTREME SCORE:     |             |         |         | 15 PERSON  | 11.3% |                    |        |      |
| MINIMUM EXTREME SCORE:     |             |         |         | 2 PERSON   | 1.5%  |                    |        |      |

10 SUMMARY OF 3 MEASURED (NON-EXTREME) ITEM

|                          | TOTAL SCORE | COUNT   | MEASURE | MODEL S.E. | INFIT |                  | OUTFIT |      |
|--------------------------|-------------|---------|---------|------------|-------|------------------|--------|------|
|                          |             |         |         |            | MNSQ  | ZSTD             | MNSQ   | ZSTD |
| MEAN                     | 361.3       | 133.0   | 50.44   | 1.69       | .97   | -.2              | .99    | -.1  |
| P.SD                     | 35.5        | .0      | 8.71    | .03        | .06   | .5               | .11    | .8   |
| S.SD                     | 43.5        | .0      | 10.67   | .03        | .08   | .6               | .14    | 1.0  |
| MAX.                     | 408.0       | 133.0   | 60.05   | 1.73       | 1.04  | .3               | 1.15   | 1.0  |
| MIN.                     | 322.0       | 133.0   | 38.96   | 1.66       | .88   | -.9              | .88    | -.8  |
| -----                    |             |         |         |            |       |                  |        |      |
| REAL RMSE                | 1.70        | TRUE SD | 8.54    | SEPARATION | 5.02  | ITEM RELIABILITY |        | .96  |
| MOD 12 RMSE              | 1.69        | TRUE SD | 8.55    | SEPARATION | 5.06  | ITEM RELIABILITY |        | .96  |
| S.E. OF ITEM MEAN = 6.16 |             |         |         |            |       |                  |        |      |

ITEM RAW SCORE-TO-MEASURE CORRELATION = -1.00  
 Global statistics: please see Table 44.  
 UMEAN=50.4436 USCALE=11.4567

Figure 2. Summary of Instrument Statistics: Respondents and Question Items

Scenario 1

Figure 3 also shows that the average student ability is 52.76, which is higher than the average problem difficulty. This means that the ability of students is higher than the difficulty level of the questions. In other words, on average the questions given are easy for students.

4 To see students' ability in arguing, we use the wright map in Figure 2. The wright map is a representation of students' abilities (left side of the vertical line) and problem difficulty (right side of the vertical line). The student at the top of the wright map is the student with the highest ability. Conversely, students who are at the bottom are students with the lowest ability.

Likewise for questions. The questions at the top are the most difficult questions, on the other hand, the questions at the bottom are the easiest questions.

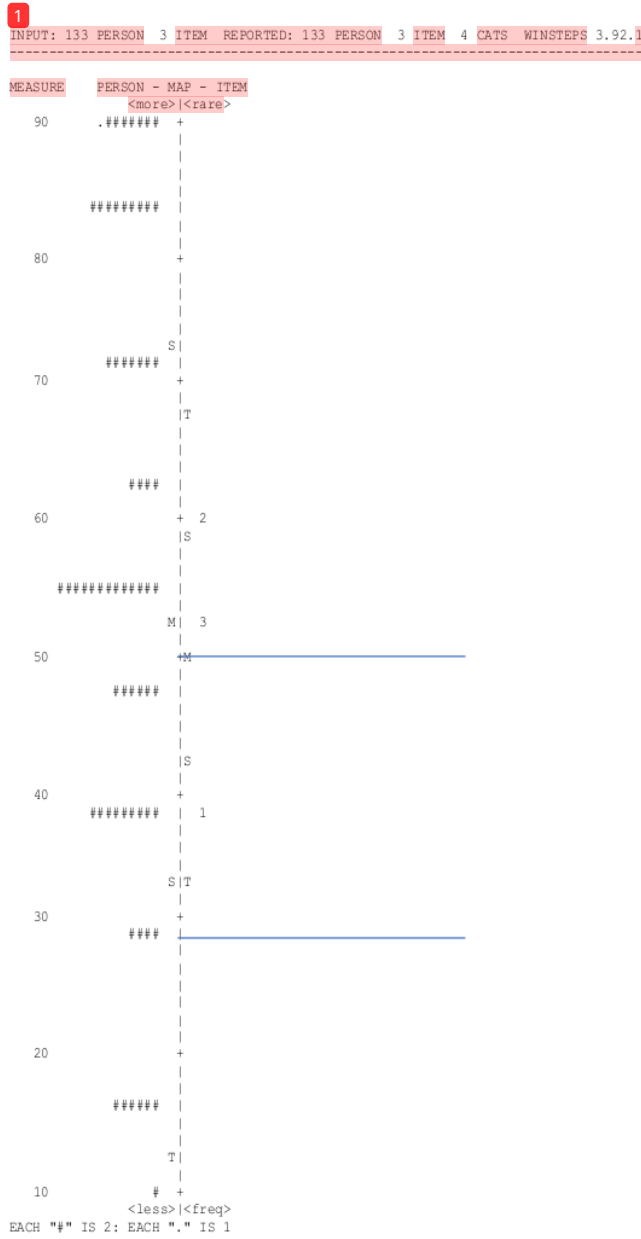


Figure 3. Hasil *wright map*

In the wright map (Figure 3) using Rasch analysis, the information on the left that describes the abilities of students shows that there are 14 people with high abilities, namely A, B, D, D, F, F, I, J, M, M, O,R,R,S,. The logit value of these students is more than +1, and 2 students are at the lowest ability, with a logit score of less than -1 logit. Based on the wright

map of students' abilities, those with high abilities, above average, below average, and with low abilities. In addition, the Wright map shows that there are two numbers that have almost the same level of difficulty, namely numbers 90 and 80. If you look back, the two indicators are the same. That is, identify reasons to support or disagree with the facts presented.

1

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INPUT: 133 PERSON 3 ITEM REPORTED: 133 PERSON 3 ITEM 4 CATS WINSTEPS 3.92.1
PERSON: REAL SEP.: 1.49 REL.: .69 ... ITEM: REAL SEP.: 5.02 REL.: .96
ITEM STATISTICS: MEASURE ORDER

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| ENTRY | TOTAL SCORE | TOTAL COUNT | MEASURE | S.E. | MODEL | INFIT | OUTFIT | PTMEASUR-AL | EXACT MATCH | ITEM |      |      |   |
|-------|-------------|-------------|---------|------|-------|-------|--------|-------------|-------------|------|------|------|---|
| 2     | 322         | 133         | 60.05   | 1.68 | .88   | -.9   | .88    | -.8         | .84         | .83  | 57.8 | 55.1 | 2 |
| 3     | 354         | 133         | 52.31   | 1.66 | .98   | -.1   | .94    | -.5         | .83         | .82  | 60.3 | 55.9 | 3 |
| 1     | 408         | 133         | 38.96   | 1.73 | 1.04  | .3    | 1.15   | 1.0         | .76         | .78  | 56.0 | 58.4 | 1 |
| MEAN  | 361.3       | 133.0       | 50.44   | 1.69 | .97   | -.2   | .99    | -.1         |             |      | 58.0 | 56.5 |   |
| P.SD  | 35.5        | .0          | 8.71    | .03  | .06   | .5    | .11    | .8          |             |      | 1.8  | 1.4  |   |

Figure 3. Item measurement results

See Figure 3 for information on the difficulty level of questions and logs for each item. The entry number column is the number of consecutive questions sorted by difficulty level, and the rightmost column of items is sorted according to what was previously entered. The items in the table are sorted by the highest log score, question number 2, and the lowest log score, question number 1. The highest log score indicates a high degree of difficulty. This corresponds to the Total Score column, which shows the number of people who answered correctly. For question number 2, a total score of 322 was achieved correctly, question number 3 was achieved with a total score of 354 correctly answered, and question number 1 was achieved with a total score of 408 correctly answered as shown in the total score column. so that in this table it can be seen that the difficulty level of question number 2 is higher with a logit value (60.05), question number 3 has a logit value (52.31) and the lowest level of difficulty is

in question number 1 with a logit value of (38, 96). The item measure also has a standard deviation value, namely (8.71).

A good research instrument must go through a test first (Brinkman, 2009), the goal is that the instrument meets the validity requirements (Md Ghazali, 2016). The instrument used has passed the expert validation stage. Expert validation is carried out with one validator with several revisions. The initial form of the instrument used was multiple choice, after which it was revised and changed to a question in the form of an essay or description. After that it was validated again and the validator gave suggestions, namely changing the questions to make them easier to understand for junior high school students. After being revised and validated again, the validator provides suggestions using the opinion form of the text which is presented as a phenomenon that occurs.

Based on the results of this study, it was found that the average student argumentation ability was already at levels 3 and 4, and there were only 2 students who were still below level 1, this indicated that students' argumentation abilities were good. This is in accordance with research conducted by (Ambarawati et al., 2021) and research conducted by (Siregar & Pakpahan, 2020).

## CONCLUSION

Berdasarkan hasil penelitian dapat disimpulkan bahwa kemampuan argumentasi siswa SMP sudah berada pada tingkat baik yaitu 50,92 persen berada pada level 3 dan 4, dan 27,04 persen berada pada level 2 dan 3 dan sisanya berada pada level 1 dan 2. Sehingga dengan demikian pemahaman siswa tentang kontekstual yang sedang terjadi sudah up to date sesuai dengan perkembangan zaman yang sedang berlangsung. Sehingga pendekatan pembelajaran SSI tentang tema terbarukan tentang Covid 19 ini sudah baik.

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