Analysis of Misconceptions of Students in Grades XI and XII of Motion System Material Using the *Six-Tier Diagnostic Test*

Venty Zuslia[1]*, Ninik Nihayati[2]
[1,] State University of Yogyakarta, [2] IAIN Kudus
*Corresponding Autor: ventyzuslia1@gmail.com

ABSTRACT

This study aims to measure the level of misconceptions of students majoring in science on the material of the motion system. The study used a quantitative approach with a descriptive method and involved 40 student respondents from classes XI and XII majoring in IPA MA Nahdlatul Muslimin. Data were collected through a six-level diagnostic test instrument with multiple choice questions, belief statements, analyzing the truth, and causes of misconceptions. In this study using the RASCH model analysis using the winstep application because it can analyze data on student objectivity in answering questions. The results showed that theoretical misconceptions had an average of 57.77%, classification misconceptions had an average of 17.99%, and correlation misconceptions had an average of 23.75%. The factors that contribute to the occurrence of misconceptions are mainly caused by students' own thoughts (60%), followed by teacher explanations (25.05%) and books (14.95%). This study concluded that the level of misconceptions was in the moderate category. To avoid misconceptions, this study suggests increasing teacher feedback and using more interactive learning models such as PBL to minimize the occurrence of misconceptions.

Keywords: Misconceptions, Movement System, Students

INTRODUCTION

Learning is a process that produces knowledge and changes behavior, to achieve the goals of education, the figure of the teacher has a very urgent influence on students in learning outcomes (Wati, 2023). The professional competence of teachers who are in charge of attitudes, education, skills, teaching, is an appreciation of one competency that must be possessed by a teacher (Sitanggang, 2023). Professional competence is the ability to master the material well and broadly and deeply (Novitasari & Susantini, 2021). So the teacher must have broad and in-depth knowledge related to the material to be conveyed during learning and be able to understand the concept so that no misconceptions occur (Lestari, 2019).

Misconception is the difference between a person's concept and the concept held by experts to create two different concepts that conflict (Yuli, 2019). The problem of understanding the concepts of students majoring in science is very important, because if misconceptions occur, it will create an understanding that is not in accordance with scientific concepts (Fauziah, 2023). Therefore, misconceptions must be diagnosed and identified early, in order to change misconceptions into the right conception (Nasution, 2021).

In 2019 research by Akbar Yuli Saputra found that there were misconceptions in students in class XI MIPA MAN 4 Bantul on the material of the motion system on average 26.03%, in the category of knowing the average concept of 39.37%, in the category of

students who did not know the average concept of 35.00% (Saputra, 2019). Departing from this statement is evidence that there are still many students majoring in science who experience misconceptions in the material of the motion system. Therefore, the researcher wants to continue the research to analyze the level of misconceptions in students, especially in students majoring in science in a different place, namely at MA Nahdlatul Muslimin. This is because of the importance of proper understanding related to theoretical, classificational, and correlational students in order to minimize misconceptions (Pakpahan, 2020).

RASCH model analysis is an analysis model of item response theory developed by Georg Rasch with the help of software, namely Winsteps. Some things that need to be considered in conducting Rasch model analysis include: First, the summary statistic value provides overall information regarding the quality of the instrument and respondents used and the interaction between person and item. Some things to note are the value of person reliability, Cronbach alpha, and item reliability. The person reliability value shows that the person answers correctly if the average is more than logit 0.0. Cronbach's alpha value shows the results of the reliability of the interaction between items and people. The item reliability and person reliability values are used to determine the reliability of the item and person (Sumintono, 2014).

Second, the Item fit order is used to check items that fit and misfit. To determine this, MNSQ (Mean Square) and ZSTD (Z Standard) and Pt Mean Corr (Point Measure Correlation) values are used. The MNSQ (Mean Square) value is the average of the squares for an item. ZSTD (Z Standard) is a transformation of the mean square value with a sample size correction. Pt Mean Corr (Point Measure Correlation) to show item validity with decision-making criteria that the instrument item is valid or not. Third, the Rasch model, person-item map (PIM) is used to display the location of respondents' (Learners') abilities and the difficulty level of items. PIM is divided into three parts: person, map, and item. Fourth, the item-person map (Wright Map) has a very important function in analyzing the subject's ability and the difficulty level of the items. Fifth, the guttman scalogram helps in depicting a scaled curve that shows the relationship between a student's level of ability (Person ability) and item difficulty. This curve helps in understanding how students behave on items of different difficulty levels (Sumintono, 2014).

The purpose of the study was to measure the level of misconceptions of students majoring in science on the material of the motion system. This study examines the level of understanding of the motion system material in MA Nahdlatul Muslimin science majors and provides PBL (Problem based learning) model treatment to minimize misconceptions in the motion system material. This research is useful for measuring the level of misconceptions of students majoring in science, especially in motion system material and providing solutions by providing PBL learning model treatment so that competent students are created and have a good understanding of motion system material (Darnelia, 2020). So this research is very important to do because it affects the process of understanding and learning biology in the future, especially on the material of the motion system.

METHODS

The research approach used is qualitative descriptive type because it is to describe the level of student misconceptions (Rochma, 2023). The variables in this study measure the level of student misconceptions on the material of the motion system and the solution to the application of learning models to minimize misconceptions (Nisa, 2023). The study population was 80 students, the subjects of this study were 40 student respondents who had received motion system material from classes XI and XII of the MA Nahdlatul Muslimin science department through stratified random sampling technique because it ensured a balanced representation of each class group so as to increase the credibility of the research results (Zaman, 2023). Data collection through google forms, namely by giving 10 questions in the form of multiple choice with a six tier diagnostic test instrument, namely students are given questions, statements of belief in answering questions, analyzing the truth in answering questions, and analyzing the causes of misconceptions in students (Imaduddin, 2023).

In this study using the RASCH model analysis using the winstep application because it can analyze student objectivity data in answering questions (Vrotsou, 2023). Content validity was carried out by the researcher by reviewing the items of the instrument according to the aspects reviewed by the researcher based on language aspects, construction aspects, and material aspects with a six-tier diagnostic test instrument to measure the level of misconceptions in students (Utami, 2023). Person reliability and item reliability values are weak categories: <0.67, fair: 0.67-0.80, good: 0.81-0.90, excellent: 0.91-0.94, excellent: >0.94. Cronbach's alpha value is poor: <0.50, poor: 0.50-0.60, fair: 0.61-0.70, good: 0.71-0.80, excellent: >0.80 (Huang, 2023).

The criteria for checking the fit of outlier/misfit test items are: Acceptable Outfit Meansquare (MNSQ) $0.5 < MNSQ < 1.5$. Outfit Z-Standard (ZSTD) which is accepted $-2.0 < ZSTD < +2.0$. Accepted Point Measure Correlation (PtMEA Corr) $0.4 < Pt\ Mea\ Corr < 0.85$. (Phipps, 2023). Test difficulty categories very difficult: $> +1.37$, difficult: 0.0 to +1.37, moderate: 0.0 to -1.37, easy: <-1.37. Student ability category high: >1.80, medium: <1.80, low: <-1.29 (Rahman, 2023).

RESULTS AND DISCUSSION

The research we conducted with a descriptive type qualitative approach with a six tier diagnostic test instrument from the rating scale rash model analysis that we conducted on July 1, 2022 - December 18, 2023, with a stratified random sampling technique of 40 students majoring in science classes XI and XII MA Nahdlatul Muslimin related to measuring the level of student misconceptions on the material of the motion system and the application of the PBL (Problem based learning) model as a solution to minimize misconceptions (Darnelia, 2020). Six-tier diagnostic test is the origin of the four-tier test and undergoes development (Sari, 2019). In the 3rd and 6th tiers, the development was experienced with the addition of a questionnaire used to analyze the causes of misconceptions in students (Onder, 2022). The characteristic of the first tier level is a multiple choice test related to scientific concepts. The second tier level is the level of confidence (LC) or the students in answering whether they are sure or not at the 1st level (Mulyani, 2023).

The third tier is a test related to the cause of choosing an answer based on what source in the first tier (Laeli, 2023). The four tier level is a test related to the reason for answering the first tier question (Istiyono, 2023). The five-tier level is the level of confidence (LC) or

choosing a test answer at the 4th level based on the student's level of confidence (Rokhim, 202023). The six tier level is a test related to the cause of choosing an answer at the 4th level from what source (Suyono, 2023). The results of this study indicate that students experience misconceptions about the motion system material and the application of the PBL model can reduce the level of student misconceptions in the motion system material.

Table 1. Average Data of Theoretical, Classificatory, and Correlational Misconceptions

No.	Student Misconceptions	Average
1	Theoretical	57,77%,
2	Classified	17,99%
3	Correlational	23,75%

Based on table 1. The results showed that theoretical misconceptions of students majoring in science had an average of 57.77%, classificational misconceptions had an average of 17.99%, correlational misconceptions of 23.75%. So it can be concluded that the level of misconception based on the average percentage level of misconceptions of students majoring in science on the material of the motion system is in the moderate category.

Table 2. Student misconception data

No	Material	Understand	Partially understand	Mis understanding	Not understanding
1	Definition of motion system Benefits of	31,8%	8,8%	53%	6.4%
2	Names of the skeletal parts of the human body	17,8%	11,9%	64%	6.3%
3	Truss function Types of motion of the relationship between bones)	38,1%	18,8%	37,5%	5,6 %
4	Truss function	11%	6,8%	79%	3.2%
5	Types of motion of the relationship between bones)	26.5%	6,8%	64.1%	2.6%
6	Types of joints	20,3%	17,2%	49%	13,5%
	Average	23,75%	11,72%	57.77%	6,27%

Based on table 2. the results showed that an average of 23.75% of students majoring in science understood the motion system material, an average of 11.72% of students majoring in science partially understood the motion system material, an average of 57.77% of students majoring in science experienced misunderstandings (Misconceptions) of motion system material, an average of 6.27% of students majoring in science did not materialize the motion system. Then the misconceptions that occur in students at a moderate stage.

Table 3. Form of Student Misconception Example

No.	Material	Correct/ Wrong	Sure	Reason for Answering	Causes of Misconception
1	Definition of motion system	Wrong	Sure it's true	Sure answer is correct	Own thoughts
2	Benefits of the movement system	Wrong	Sure it's true	Sure answer is correct	Own thoughts
3	Names of the skeletal Parts of the human body	Wrong	Sure it's true	Sure answer is correct	Own thoughts
4	Truss function	Wrong	Sure it's true	Sure answer is correct	Teacher explanation
5	Types of motion of the relationship between bones)	Wrong	Sure it's true	Sure answer is correct	Teacher explanation
6	Types of joints	Wrong	Sure it's true	Sure answer is correct	Books

Based on table 3. examples of student misconceptions in the definition of motion system, benefits of the movement system, names of the skeletal parts of the human body: The student is confident in answering the question, but the answer and the reason for answering are wrong due to the error of own thoughts. On truss function and ypes of motion of the relationship between bones): Students are confident in answering the question, but the answers and reasons are wrong due to teacher explanation errors. On types of joints: Students were confident in answering the question, but the answers and reasons were incorrect due to misunderstanding of the book.

Table 4. Score ranking data

No.	Students are sure/not		Students are correct / not		Score	
	009P (Highest Utility)	037P (Lowest Utility)	009P (Highest Abalities)	037P (Lowest Utility)	009P (Highest Utility)	037P (Lowest Utility)
1	Sure	Very unsure	Correct	Wrong	1	0
2	Less sure	Less sure	Correct	Wrong	1	1
3	Sure	Less sure	Correct	Correct	1	1
4	Sure	Sure	Correct	Wrong	1	0
5	Sure	Less sure	Correct	Wrong	1	0
6	Sure	Sure	Correct	Wrong	1	0
7	Sure	Less sure	Correct	Wrong	1	0
8	Sure	Less sure	Correct	Wrong	1	0
9	Sure	Sure	Correct	Wrong	1	0
10	Very unsure	Less sure	Correct	Wrong	1	0

Based on table 4. The results showed that 009P (highest ability) on average was confident in answering the test answers because student number 009P understood the concept of motion system material. Meanwhile, student 037P (lowest ability) on average was less confident in

answering the test answers because student number 037P did not understand the motion system material and just guessed in answering.

Table 5. Data on the Causes of Misconceptions

No.	Causes of Misconception	Average
1	Own thoughts	60%,
2	Teacher explanation	25,05%,
3	Books	14,95%.

Based on table 5. The results showed that the factors for the occurrence of misconceptions in students were caused by their own minds on average by 60%, derived from the teacher's explanation on average by 25.05%, derived from the book on average by 14.95%. The largest average point is from one's own mind, so avoiding misconceptions is to increase teacher feedback to students after delivering material by asking students for the results of delivering material to clarify theoretical, classificatory, correlational errors and using more interactive learning models such as PBL which can minimize the occurrence of misconceptions.

Table 6. Application of PBL (*Problem Base Learning*) Model

No.	Student Misconceptions	Average
1	Theoretical	5%,
2	Classified	2,1%
3	Correlational	2,9%

Based on table 6. The results showed that theoretical misconceptions of students majoring in science, which initially before the application of the PBL model had an average of 57.77%, changed to 5%, classificatory misconceptions which initially before the application of the PBL model had an average of 17.99% changed to 2.1%, and correlational misconceptions which initially before the application of the PBL model had an average of 23.75% changed to 2.9%. So it can be concluded that using the PBL learning model can minimize the occurrence of misconceptions.

RASCH Model Analysis Table with Winstep

```
-------------------------------------------------------------------------
|           TOTAL                        MODEL      INFIT      OUTFIT    |
|           SCORE    COUNT    MEASURE    ERROR    MNSQ  ZSTD  MNSQ  ZSTD |
|-----------------------------------------------------------------------|
| MEAN       3.6      6.0        .71     1.05                            |
| S.D.       1.1       .0       1.15      .25                            |
| MAX.       6.0      6.0       3.45     1.90                            |
| MIN.       2.0      6.0       -.85      .93     .52  -1.4   .44  -1.0  |
|-----------------------------------------------------------------------|
| REAL RMSE   1.15 TRUE SD   .07  SEPARATION  .06  PERSON RELIABILITY .00|
| MODEL RMSE  1.08 TRUE SD   .39  SEPARATION  .36  PERSON RELIABILITY .11|
| S.E. OF PERSON MEAN = .18                                             |
-------------------------------------------------------------------------
```

```
PERSON RAW SCORE-TO-MEASURE CORRELATION = .99
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .07

    SUMMARY OF 6 MEASURED (NON-EXTREME) ITEM
-------------------------------------------------------------------------
|            TOTAL                     MODEL|    INFIT    |   OUTFIT    |
|            SCORE    COUNT    MEASURE  ERROR|  MNSQ  ZSTD|  MNSQ  ZSTD |
|-----------------------------------------------------------------------|
| MEAN       24.3     40.0       .00    .41 |   .99   -.1| 1.03    .1  |
| S.D.        7.7      .0       1.22    .09 |   .12    .8|  .19    .9  |
| MAX.       37.0     40.0      1.49    .62 |  1.13    .8| 1.21   1.0  |
| MIN.       14.0     40.0     -2.25    .36 |   .80  -1.3|  .69  -1.2  |
|-----------------------------------------------------------------------|
| REAL RMSE    .43 TRUE SD   1.14  SEPARATION 2.63  ITEM  RELIABILITY .87|
| MODEL RMSE   .42 TRUE SD   1.14  SEPARATION 2.70  ITEM  RELIABILITY .88|
| S.E. OF ITEM MEAN = .55                                               |
-------------------------------------------------------------------------
UMEAN=.0000 USCALE=1.0000
ITEM RAW SCORE-TO-MEASURE CORRELATION = -.99
222 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 230.15 with 180 d.f. p=.0068
Global Root-Mean-Square Residual (excluding extreme scores): .4141
Capped Binomial Deviance = .2086 for 240.0 dichotomous observations
```

Figure 1. Summary of measured

Based on figure 1. the RASCH model analysis with winstep above, the results of person reliability 0.11 are weak, Cronbach alpha 0.07 (Poor), item reliability 0.88 (Good). So the interpretation of the results of the reliability analysis is that the answers from students are less consistent, but the quality of the test items in the instrument in the reliability aspect is in the "Good" category. The Cronbach alpha value is in the "Poor" category.

```
-------------------------------------------------------------------------------
|ENTRY  TOTAL  TOTAL          MODEL|  INFIT  | OUTFIT  |PT-MEASURE |EXACT MATCH|      |
|NUMBER SCORE  COUNT  MEASURE  S.E. |MNSQ ZSTD|MNSQ ZSTD|CORR.  EXP.| OBS%  EXP%| ITEM |
|-----------------------------------------------------------------------------------|
|   5     27     40    -.23    .37|1.13   .8|1.21  1.0|A .30   .41| 64.9 71.3| 1.5 |
|   2     29     40    -.51    .39|1.01   .1|1.21   .8|B .34   .39| 81.1 73.8| 1.2 |
|   3     37     40   -2.25    .62|1.05   .3|1.13   .4|C .16   .22| 91.9 91.8| 1.3 |
|   1     17     40    1.07    .37|1.10   .8|1.10   .6|c .41   .48| 62.2 66.9| 1.1 |
|   6     22     40     .43    .36| .87 -1.1| .85  -.9|b .55   .45| 78.4 67.4| 1.6 |
|   4     14     40    1.49    .38| .80 -1.3| .69 -1.2|a .65   .50| 81.1 73.0| 1.4 |
|-----------------------------------------------------------------------------------|
| MEAN  24.3   40.0     .00    .41| .99  -.1|1.03   .1|           | 76.6 74.0|      |
| S.D.   7.7    .0     1.22    .09| .12   .8| .19   .9|           | 10.2  8.4|      |
-------------------------------------------------------------------------------------
```

Figure 2. Item statistic: misfit order

Based on figure 2. the RASCH model analysis with winstep above, the results of all test items number 2, 3, 6, and 4 MNSQ are accepted (Meets the criteria), test items number 1 and 5 MNSQ are not accepted (Does not meet the criteria). Test items are all ZSTD accepted (Meets the criteria). Test items number 1, 4, 5, and 6 Pt Mea Corr are accepted (Meets the criteria), test items number 2 and 3 are not accepted (Does not meet the criteria). From the above results that the test items are still considered fit (The items are retained), because none of the three are not accepted MNSQ, ZSTD, and Pt Mea Corr.

```
-------------------------------------------------------------------------------
|ENTRY  TOTAL  TOTAL          MODEL|  INFIT  | OUTFIT  |PT-MEASURE |EXACT MATCH|      |
|NUMBER SCORE  COUNT  MEASURE  S.E. |MNSQ ZSTD|MNSQ ZSTD|CORR.  EXP.| OBS%  EXP%| ITEM |
|-----------------------------------------------------------------------------------|
|   4     14     40    1.49    .38| .80 -1.3| .69 -1.2| .65   .50| 81.1 73.0| 1.4 |
|   1     17     40    1.07    .37|1.10   .8|1.10   .6| .41   .48| 62.2 66.9| 1.1 |
|   6     22     40     .43    .36| .87 -1.1| .85  -.9| .55   .45| 78.4 67.4| 1.6 |
|   5     27     40    -.23    .37|1.13   .8|1.21  1.0| .30   .41| 64.9 71.3| 1.5 |
|   2     29     40    -.51    .39|1.01   .1|1.21   .8| .34   .39| 81.1 73.8| 1.2 |
|   3     37     40   -2.25    .62|1.05   .3|1.13   .4| .16   .22| 91.9 91.8| 1.3 |
|-----------------------------------------------------------------------------------|
| MEAN  24.3   40.0     .00    .41| .99  -.1|1.03   .1|           | 76.6 74.0|      |
| S.D.   7.7    .0     1.22    .09| .12   .8| .19   .9|           | 10.2  8.4|      |
-------------------------------------------------------------------------------------
```

Figure 3. Item statistic: measure order

Based on figure 3. the RASCH model analysis with winstep above, the results of test item number 4 in the very difficult category, test items number 1 and 6 in the difficult

category, test items number 2 and 5 in the moderate category, test item number 3 in the easy category.

```
              PERSON - MAP - ITEM
                <more>|<rare>
     3            .#  +
                      |
                      |
                      |
                      |T
                    T |
     2            ##  +
                      |
                      |
                  [ ] |  1.4
                    S |
                      |S
                      |   1.1
     1              + 
      .########    |
                      |
                    M |
                      |   1.6
          ####      |
     0            +M
                      |
                      |   1.5
                    S |
                      |   1.2
          ####      |
    -1              +
                      |S
                    T |
                      |
                      |
                      |
    -2              +
                      |
                  [ ] |  1.3
                      |T
                      |
                      |
                      |
    -3              +
                <less>|<frequ>
     EACH "#" IS 2. EACH "." IS 1.
```
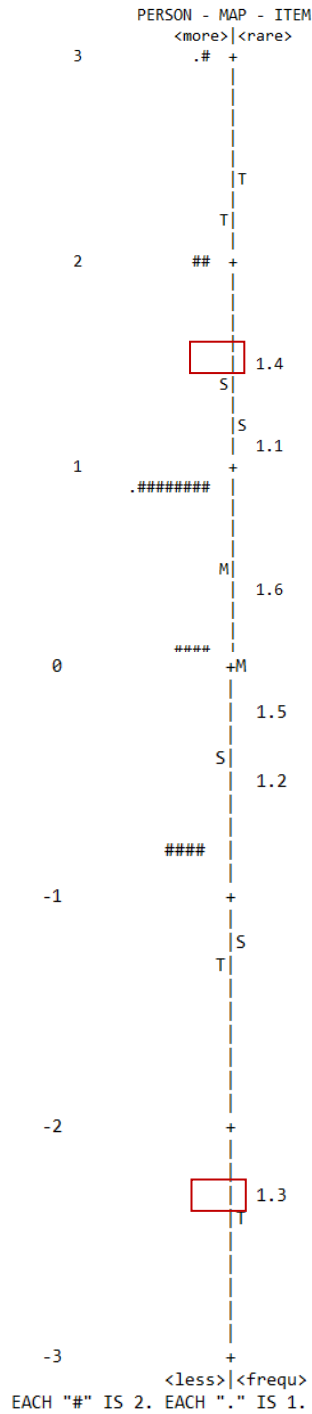
Figure 4. Person map item

Based on figure 4. person map item the RASCH model analysis with winstep above, the results of the test items with the most difficult to do number 1.4 (Number 4). While the test items that are very easy to do are number 1.3 (Number 3).
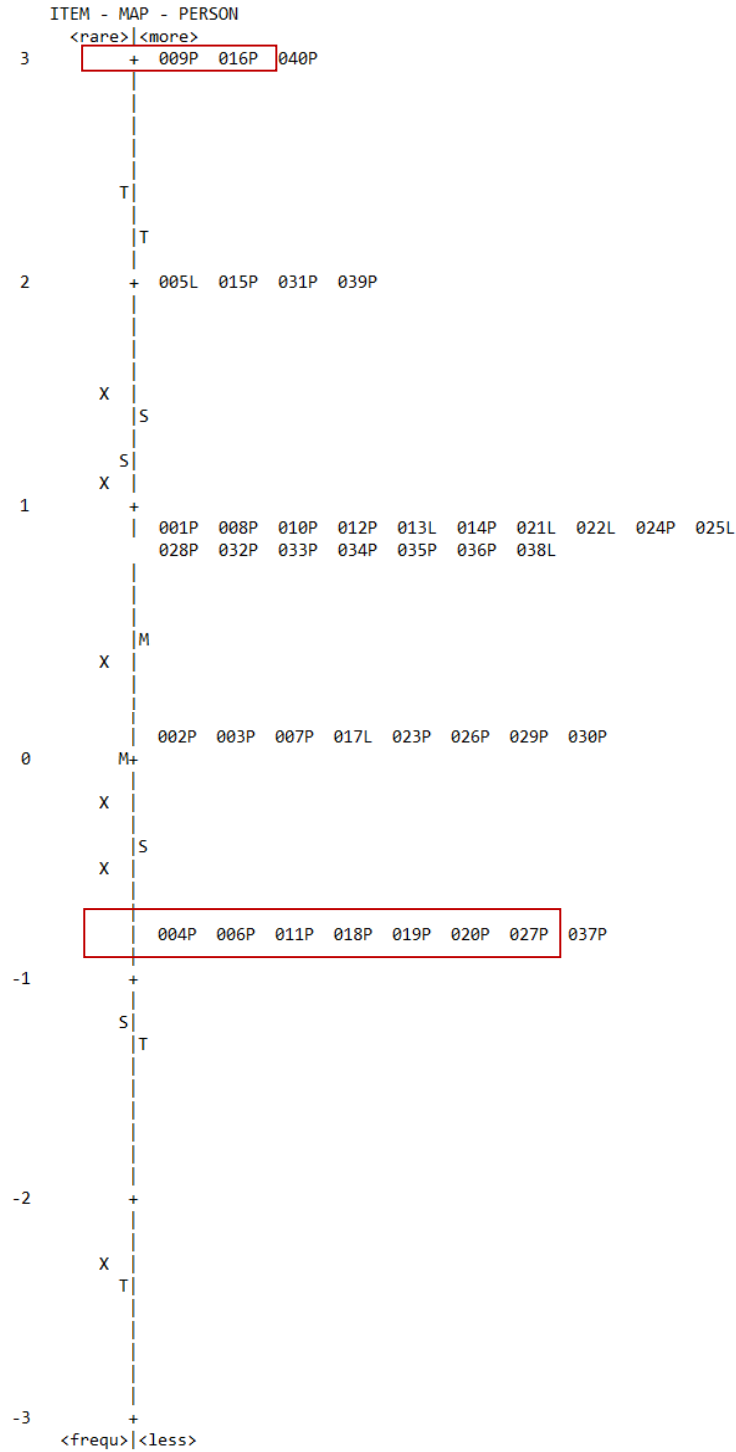
```
ITEM - MAP - PERSON
    <rare>|<more>
 3       +  009P  016P  040P
         |
         |
         |
       T |
         |T
 2       +  005L  015P  031P  039P
         |
         |
       X |
         |S
       S |
       X |
 1       +
         |  001P  008P  010P  012P  013L  014P  021L  022L  024P  025L
         |  028P  032P  033P  034P  035P  036P  038L
         |
         |
         |M
       X |
         |
         |  002P  003P  007P  017L  023P  026P  029P  030P
 0     M +
       X |
         |S
       X |
         |  004P  006P  011P  018P  019P  020P  027P  037P
-1       +
       S |
         |T
         |
         |
         |
-2       +
         |
       X |
       T |
         |
         |
         |
-3       +
    <frequ>|<less>
```

Figure 5. Item map person

Based on figure 5. item map person the analysis of the RASCH model with winstep above, the results of students with the highest abilities are students number 009P, 016P, and 040P (Students number 9, 16, and 40). While students who have the lowest ability are student numbers 004P, 006P, 011P, 018P, 019P, 020P, 027P, and 037P (Student numbers 4, 6, 11, 18, 19, 20, 27, 37).

```
----------------------------------------------------------------------------
|ENTRY  TOTAL  TOTAL          MODEL|   INFIT  |  OUTFIT  |PT-MEASURE |EXACT MATCH|
|NUMBER SCORE  COUNT MEASURE   S.E. |MNSQ  ZSTD|MNSQ  ZSTD|CORR.  EXP.| OBS%  EXP%| PERSON
|---------------------------------+----------+----------+-----------+-----------+-------
|    9      6      6    3.45    1.90|   MAXIMUM MEASURE|    .00    .00|100.0 100.0| 009P
|   16      6      6    3.45    1.90|   MAXIMUM MEASURE|    .00    .00|100.0 100.0| 016P
|   40      6      6    3.45    1.90|   MAXIMUM MEASURE|    .00    .00|100.0 100.0| 040P
|    5      5      6    2.02    1.16|1.49   .9|2.31   1.2| -.19   .31| 83.3  83.3| 005L
|   15      5      6    2.02    1.16|1.43   .8|1.78    .9| -.08   .31| 83.3  83.3| 015P
|   31      5      6    2.02    1.16| .94   .1| .59    .1|  .39   .31| 83.3  83.3| 031P
|   39      5      6    2.02    1.16| .94   .1| .59    .1|  .39   .31| 83.3  83.3| 039P
|    1      4      6     .94     .96|1.02   .2| .81    .1|  .44   .42| 66.7  72.1| 001P
|    8      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 008P
|   10      4      6     .94     .96|1.08   .3| .97    .3|  .37   .42| 66.7  72.1| 010P
|   12      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 012P
|   13      4      6     .94     .96|1.65  1.6|1.53    .8| -.02   .42| 33.3  72.1| 013L
|   14      4      6     .94     .96|1.02   .2| .81    .1|  .44   .42| 66.7  72.1| 014P
|   21      4      6     .94     .96|1.90  2.0|1.84   1.1| -.21   .42| 33.3  72.1| 021L
|   22      4      6     .94     .96|1.08   .3| .97    .3|  .37   .42| 66.7  72.1| 022L
|   24      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 024P
|   25      4      6     .94     .96|1.36  1.0|1.31    .6|  .16   .42| 66.7  72.1| 025L
|   28      4      6     .94     .96|2.26  2.6|5.41   2.9| -.80   .42| 33.3  72.1| 028P
|   32      4      6     .94     .96| .83  -.3| .66   -.1|  .56   .42| 66.7  72.1| 032P
|   33      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 033P
|   34      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 034P
|   35      4      6     .94     .96|1.08   .3| .97    .3|  .37   .42| 66.7  72.1| 035P
|   36      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 036P
|   38      4      6     .94     .96| .83  -.3| .66   -.1|  .56   .42| 66.7  72.1| 038L
|    2      3      6     .07     .93|1.05   .3| .94    .1|  .46   .48| 66.7  70.9| 002P
|   13      4      6     .94     .96|1.65  1.6|1.53    .8| -.02   .42| 33.3  72.1| 013L
|   14      4      6     .94     .96|1.02   .2| .81    .1|  .44   .42| 66.7  72.1| 014P
|   21      4      6     .94     .96|1.90  2.0|1.84   1.1| -.21   .42| 33.3  72.1| 021L
|   22      4      6     .94     .96|1.08   .3| .97    .3|  .37   .42| 66.7  72.1| 022L
|   24      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 024P
|   25      4      6     .94     .96|1.36  1.0|1.31    .6|  .16   .42| 66.7  72.1| 025L
|   28      4      6     .94     .96|2.26  2.6|5.41   2.9| -.80   .42| 33.3  72.1| 028P
|   32      4      6     .94     .96| .83  -.3| .66   -.1|  .56   .42| 66.7  72.1| 032P
|   33      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 033P
|   34      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 034P
|   35      4      6     .94     .96|1.08   .3| .97    .3|  .37   .42| 66.7  72.1| 035P
|   36      4      6     .94     .96| .54  -1.3| .44   -.5|  .74   .42|100.0  72.1| 036P
|   38      4      6     .94     .96| .83  -.3| .66   -.1|  .56   .42| 66.7  72.1| 038L
|    2      3      6     .07     .93|1.05   .3| .94    .1|  .46   .48| 66.7  70.9| 002P
|    3      3      6     .07     .93|1.05   .3| .94    .1|  .46   .48| 66.7  70.9| 003P
|    7      3      6     .07     .93| .80  -.4| .67   -.4|  .64   .48| 66.7  70.9| 007P
|   17      3      6     .07     .93|1.63  1.6|2.52   2.1| -.09   .48| 66.7  70.9| 017L
|   23      3      6     .07     .93| .52  -1.4| .45  -1.0|  .82   .48|100.0  70.9| 023P
|   26      3      6     .07     .93| .52  -1.4| .45  -1.0|  .82   .48|100.0  70.9| 026P
|   29      3      6     .07     .93|1.18   .6|1.20    .5|  .35   .48| 66.7  70.9| 029P
|   30      3      6     .07     .93| .52  -1.4| .45  -1.0|  .82   .48|100.0  70.9| 030P
|    4      2      6    -.85    1.00| .71  -.4| .56   -.5|  .72   .50| 83.3  76.7| 004P
|    6      2      6    -.85    1.00| .71  -.4| .56   -.5|  .72   .50| 83.3  76.7| 006P
|   11      2      6    -.85    1.00| .98   .1| .89    .1|  .53   .50| 83.3  76.7| 011P
|   18      2      6    -.85    1.00| .71  -.4| .56   -.5|  .72   .50| 83.3  76.7| 018P
|   19      2      6    -.85    1.00| .98   .1| .89    .1|  .53   .50| 83.3  76.7| 019P
|   20      2      6    -.85    1.00|1.16   .5|1.45    .8|  .34   .50| 83.3  76.7| 020P
|   27      2      6    -.85    1.00|1.49  1.0|1.31    .6|  .21   .50| 50.0  76.7| 027P
|   37      2      6    -.85    1.00| .58  -.8| .45   -.7|  .80   .50| 83.3  76.7| 037P
|---------------------------------+----------+----------+-----------+-----------+-------
| MEAN    3.6    6.0     .71    1.05| .99   .0|1.03    .1|           | 76.6  74.0|
| S.D.    1.1     .0    1.15     .25| .42  1.0| .90    .8|           | 18.8   3.8|
----------------------------------------------------------------------------
```

Figure 6. Person statistic: measure order

Based on figure 6. person statistic: measure order the RASCH model analysis with winstep above, the results of the person measure, students who have the best test completion skills are students number 009P, 016P, 0040P with a logit value of +3.45, while students with the lowest test completion skills are students number 004P, 006P, 011P, 018P, 019P, 020P, 027P, and 037P with a logit of -0.85.

```
-----------------------------------------------------------------------------------------
|ENTRY   TOTAL TOTAL           MODEL|  INFIT  |  OUTFIT |PT-MEASURE |EXACT MATCH|        |
|NUMBER  SCORE COUNT MEASURE   S.E. |MNSQ ZSTD|MNSQ ZSTD|CORR.  EXP.| OBS%  EXP%| PERSON |
-----------------------------------------------------------------------------------------
|   28     4     6    .94      .96 |2.26  2.6|5.41  2.9|A-.80  .42| 33.3  72.1| 028P   |
|   17     3     6    .07      .93 |1.63  1.6|2.52  2.1|B-.09  .48| 66.7  70.9| 017L   |
|    5     5     6   2.02     1.16 |1.49   .9|2.31  1.2|C-.19  .31| 83.3  83.3| 005L   |
|   21     4     6    .94      .96 |1.90  2.0|1.84  1.1|D-.21  .42| 33.3  72.1| 021L   |
|   15     5     6   2.02     1.16 |1.43   .8|1.78   .9|E-.08  .31| 83.3  83.3| 015P   |
|   13     4     6    .94      .96 |1.65  1.6|1.53   .8|F-.02  .42| 33.3  72.1| 013L   |
|   27     2     6   -.85     1.00 |1.49  1.0|1.31   .6|G .21  .50| 50.0  76.7| 027P   |
|   20     2     6   -.85     1.00 |1.16   .5|1.45   .8|H .34  .50| 83.3  76.7| 020P   |
|   25     4     6    .94      .96 |1.36  1.0|1.31   .6|I .16  .42| 66.7  72.1| 025L   |
|   29     3     6    .07      .93 |1.18   .6|1.20   .5|J .35  .48| 66.7  70.9| 029P   |
|   10     4     6    .94      .96 |1.08   .3| .97   .3|K .37  .42| 66.7  72.1| 010P   |
|   22     4     6    .94      .96 |1.08   .3| .97   .3|L .37  .42| 66.7  72.1| 022L   |
|   35     4     6    .94      .96 |1.08   .3| .97   .3|M .37  .42| 66.7  72.1| 035P   |
|    2     3     6    .07      .93 |1.05   .3| .94   .1|N .46  .48| 66.7  70.9| 002P   |
|    3     3     6    .07      .93 |1.05   .3| .94   .1|O .46  .48| 66.7  70.9| 003P   |
|    1     4     6    .94      .96 |1.02   .2| .81   .1|P .44  .42| 66.7  72.1| 001P   |
|   14     4     6    .94      .96 |1.02   .2| .81   .1|Q .44  .42| 66.7  72.1| 014P   |
|   11     2     6   -.85     1.00 | .98   .1| .89   .1|R .53  .50| 83.3  76.7| 011P   |
|   19     2     6   -.85     1.00 | .98   .1| .89   .1|S .53  .50| 83.3  76.7| 019P   |
|   31     5     6   2.02     1.16 | .94   .1| .59   .1|r .39  .31| 83.3  83.3| 031P   |
|   39     5     6   2.02     1.16 | .94   .1| .59   .1|q .39  .31| 83.3  83.3| 039P   |
|   32     4     6    .94      .96 | .83  -.3| .66  -.1|p .56  .42| 66.7  72.1| 032P   |
|   38     4     6    .94      .96 | .83  -.3| .66  -.1|o .56  .42| 66.7  72.1| 038L   |
|    7     3     6    .07      .93 | .80  -.4| .67  -.4|n .64  .48| 66.7  70.9| 007P   |
|    4     2     6   -.85     1.00 | .71  -.4| .56  -.5|m .72  .50| 83.3  76.7| 004P   |
|   10     4     6    .94      .96 |1.08   .3| .97   .3|K .37  .42| 66.7  72.1| 010P   |
|   22     4     6    .94      .96 |1.08   .3| .97   .3|L .37  .42| 66.7  72.1| 022L   |
|   35     4     6    .94      .96 |1.08   .3| .97   .3|M .37  .42| 66.7  72.1| 035P   |
|    2     3     6    .07      .93 |1.05   .3| .94   .1|N .46  .48| 66.7  70.9| 002P   |
|    3     3     6    .07      .93 |1.05   .3| .94   .1|O .46  .48| 66.7  70.9| 003P   |
|    1     4     6    .94      .96 |1.02   .2| .81   .1|P .44  .42| 66.7  72.1| 001P   |
|   14     4     6    .94      .96 |1.02   .2| .81   .1|Q .44  .42| 66.7  72.1| 014P   |
|   11     2     6   -.85     1.00 | .98   .1| .89   .1|R .53  .50| 83.3  76.7| 011P   |
|   19     2     6   -.85     1.00 | .98   .1| .89   .1|S .53  .50| 83.3  76.7| 019P   |
|   31     5     6   2.02     1.16 | .94   .1| .59   .1|r .39  .31| 83.3  83.3| 031P   |
|   39     5     6   2.02     1.16 | .94   .1| .59   .1|q .39  .31| 83.3  83.3| 039P   |
|   32     4     6    .94      .96 | .83  -.3| .66  -.1|p .56  .42| 66.7  72.1| 032P   |
|   38     4     6    .94      .96 | .83  -.3| .66  -.1|o .56  .42| 66.7  72.1| 038L   |
|    7     3     6    .07      .93 | .80  -.4| .67  -.4|n .64  .48| 66.7  70.9| 007P   |
|    4     2     6   -.85     1.00 | .71  -.4| .56  -.5|m .72  .50| 83.3  76.7| 004P   |
|    6     2     6   -.85     1.00 | .71  -.4| .56  -.5|l .72  .50| 83.3  76.7| 006P   |
|   18     2     6   -.85     1.00 | .71  -.4| .56  -.5|k .72  .50| 83.3  76.7| 018P   |
|   37     2     6   -.85     1.00 | .58  -.8| .45  -.7|j .80  .50| 83.3  76.7| 037P   |
|    8     4     6    .94      .96 | .54 -1.3| .44  -.5|i .74  .42|100.0  72.1| 008P   |
|   12     4     6    .94      .96 | .54 -1.3| .44  -.5|h .74  .42|100.0  72.1| 012P   |
|   24     4     6    .94      .96 | .54 -1.3| .44  -.5|g .74  .42|100.0  72.1| 024P   |
|   33     4     6    .94      .96 | .54 -1.3| .44  -.5|f .74  .42|100.0  72.1| 033P   |
|   34     4     6    .94      .96 | .54 -1.3| .44  -.5|e .74  .42|100.0  72.1| 034P   |
|   36     4     6    .94      .96 | .54 -1.3| .44  -.5|d .74  .42|100.0  72.1| 036P   |
|   23     3     6    .07      .93 | .52 -1.4| .45 -1.0|c .82  .48|100.0  70.9| 023P   |
|   26     3     6    .07      .93 | .52 -1.4| .45 -1.0|b .82  .48|100.0  70.9| 026P   |
|   30     3     6    .07      .93 | .52 -1.4| .45 -1.0|a .82  .48|100.0  70.9| 030P   |
-----------------------------------------------------------------------------------------
| MEAN   3.6   6.0    .71     1.05 | .99   .0|1.03   .1|           | 76.6  74.0|        |
| S.D.   1.1    .0   1.15      .25 | .42  1.0| .90   .8|           | 18.8   3.8|        |
-----------------------------------------------------------------------------------------
```

Figure 7. Person statistic: misfit order

Description of figure 7. person statistic: misfit order the red box is not accepted. Based on the RASCH model analysis with winstep above, the student response pattern is still fit because there are no students whose third ZSTD, MNSQ, and PT Measure COOR are not accepted.

```
PERSON |ITEM
       |325614
       |------
     9 +111111  009P
    16 +111111  016P
    40 +111111  040P
     5 +101111  005L
    15 +110111  015P
    31 +111101  031P
    39 +111101  039P
     1 +111001  001P
     8 +111100  008P
    10 +110110  010P
    12 +111100  012P
    13 +101011  013L
    14 +111001  014P
    21 +100111  021L
    22 +110110  022L
    24 +111100  024P
    25 +101101  025L
    28 +001111  028P
    32 +111010  032P
    33 +111100  033P
    34 +111100  034P
    35 +110110  035P
    36 +111100  036P
    38 +111010  038L
     2 +110010  002P
     3 +110010  003P
     7 +110100  007P
    17 +011010  017L
    23 +111000  023P
    26 +111000  026P
    29 +110001  029P
    30 +111000  030P
     4 +101000  004P
     6 +101000  006P
    11 +100100  011P
    18 +101000  018P
    19 +100100  019P
    20 +100010  020P
    27 +011000  027P
    37 +110000  037P
       |------
       |325614
```

Figure 8. Guttman scalogram of responses

Based on Figure 8. guttman scalogram of responses the RASCH model analysis with winstep above, the results of student numbers 009P, 016P, 0040P with a logit value of +3.45 are included in the highest ability student category. It can be seen that student 027P with a logit value of -0.85 but can correctly answer test number 2 with a logit value of -0.51 and test number 5 with a logit value of -0.23, then the student when answering tests number 2 and 5 just guess (Lucky guess). Then the response of student number 027P is not fit or not ideal. It happened to student number 037P with a logit value of -0.85 but could do test number 2 with a logit value of -0.51 correctly. So the student when answering test number 2 just guessed (Lucky guess). Then the response of student number 037P is not fit or not ideal.

On the scalogram, student 005L with a logit value of +2.02 cannot answer test number 2 correctly, where the test item number logit value is lower than the logit value of student 005L's ability, which is -0.51. Where 005L students should be able to answer correctly. This

indicates that in answering question number 2, he experienced carelessness in answering the test. This causes student 005L's response to be unfit or not ideal.

The response patterns of student numbers 002P and 003P are exactly the same, so there is an indication of cheating in taking the test. Likewise, the response patterns of student numbers 023P and 026P are exactly the same, so there is also an indication of cheating in taking the test. And the response patterns of student numbers 004P and 006P are exactly the same, so there is also an indication of cheating in taking the test.

From the results of data analysis, it is obtained that most students majoring in science experience misconceptions. The reason for having misconceptions is because one of them is the individual factor of the student, namely students have initial scientific insights that sometimes differ from the concepts of appropriate knowledge, although sometimes there are some whose knowledge is appropriate. On the other hand, there are several other factors that make the misconceptions experienced by students, namely the teacher's inaccuracy when delivering teaching materials and conveying knowledge, the lack of use of media and learning models that support the delivery of material, textbooks used by students and teachers that are sometimes inaccurate so that providing inaccurate concepts will make students experience misconceptions. So the lack of understanding and misconceptions experienced by students can lead to misunderstanding the correct concept, so that at a later stage, students' misconceptions get negative results for their understanding that is not in accordance with the truth.

CONCLUSIONS

The results of data analysis research obtained most of the students majoring in science class XI, and XII MA Nahdlatul Muslimin experienced misconceptions, namely theoretical misconceptions of students majoring in science which initially before the application of PBL models had an average of 57.77%, changing to 5%, classificational misconceptions which initially before the application of PBL models had an average of 17.99% changing to 2.1%, and correlational misconceptions which initially before the application of PBL models had an average of 23.75% changing to 2.9%. So it can be concluded that using the PBL learning model can minimize the occurrence of misconceptions.

Based on the RASCH model analysis with winstep get the results of person reliability 0.11 weak, Cronbach alpha 0.07 (Poor), item reliability 0.88 (Good). So the interpretation of the results of the reliability analysis is that the answers from students are less consistent, but the quality of the test items in the instrument in the reliability aspect is in the "Good" category. The Cronbach alpha value is in the "Poor" category.

Based on the RASCH model analysis with winstep, the results of all test items number 2, 3, 6, and 4 MNSQ are accepted (Meet the criteria), test items number 1 and 5 MNSQ are not accepted (have not met the criteria). Test items are all ZSTD accepted (Meets the criteria). Test items number 1, 4, 5, and 6 Pt Mea Corr accepted (Meets the criteria), test items number 2 and 3 not accepted (Does not meet the criteria). Test items are still considered fit (Item retained), because none of the three are not accepted MNSQ, ZSTD, and Pt Mea Corr. The test item with the most difficult to do is number 1.4 (Number 4). While the test item that is very easy to do is number 1.3 (Number 3).

This research is expected to affect the biology learning process for the future, especially on the material of the motion system. So from this research students can minimize the occurrence of misconceptions and can improve the professional competence of students majoring in science in mastering the material by increasing teacher feedback to students after the delivery of material by asking students for the results of the delivery of material to clarify theoretical, classificational, correlational errors and using a learning model PBL which can minimize the occurrence of misconceptions.

REFERENSI

Fauziah, A., & Ananda, L. J. (2023). Analisis Miskonsepsi Menggunakan Certainty of Response Index pada Materi Suhu dan Kalor Tema 6. *Paedagogi: Jurnal Kajian Ilmu Pendidikan (e-journal)*, *9*(2) 165-172. https://www.researchgate.net/publication/376382880_analisis_miskonsepsi_mengg unakan_certainty_of_response_index_pada_materi_suhu_dan_kalor_tema_6.

Huang, M., Chen, T., Zhou, C., Wang, Y., Zeng, H., Lu, X., & Cao, J. (2023). RASCH Analysis of the 32-Item Motor Function Measure in Ambulant Patients with Duchenne Muscular Dystrophy. *Clinical Rehabilitation*, *37*(4) 569-582. https://doi.org/10.1177/02692155221135843.

Imaduddin, M., Shofa, M. M., Riza, M. F., & Fikri, A. A. (2023). Exploring the pre-Service Basic Science Teachers' Misconceptions Using the Six-Tier Diagnostic Test. *International Journal of Evaluation and Research in Education (IJERE)*, *12*(3) 1626-1636. https://doi.org/10.11591/ijere.v12i3.24603.

Istiyono, E., Dwandaru, W. S. B., Fenditasari, K., Ayub, M. R. S. S. N., & Saepuzaman, D. (2023). The Development of a Four-Tier Diagnostic Test Based on Modern Test Theory in Physics Education. *European Journal of Educational Research*, *12*(1) 371-385. https://doi.org/10.12973/eu-jer.12.1.371.

Laeli, C. M. A. H. (2023). The 3 Tier Multiple-Choice Diagnostic Test: An Identified Instrument for Primary Students' Science Misconception. *Pegem Journal of Education and Instruction*, *13*(2) 103-111. https://eric.ed.gov/?id=EJ1386871.

Lestari, D., Handayani, D., Darussyamsu, R., & Armen, A. (2019). Identification Students' Misconceptions of Class VIII SMPN 21 Padang in the Skeletal Systems of Organism by Using CRI Technique. *Jurnal Atrium Pendidikan Biologi*, *4*(1) 135-142. https://ejournal.unp.ac.id/students/index.php/pbio/article/view/5470.

Nasution, R. H., Wijaya, T. T., Adi Putra, M. J., & Hermita, N. (2021). Analisis Miskonsepsi Siswa SD pada Materi Gaya dan Gerak. *Journal Of Natural Science And Integration*, *4*(1) 11-21. https://www.academia.edu/download/82871068/10851-36775-1-PB.pdf.

Mulyani, S., Pratiwi, E. F., & Mulyani, B. (2023). Analysis of Students Misconceptions Using Two-Tier Multiplechoice Diagnostic Tests on Acid-Base Material: Distractor Analysis. In *AIP Conference Proceedings*, *2540*(1) 040007. https://pubs.aip.org/aip/acp/article-abstract/2540/1/040007/2873456.

Nisa, U. S., & A'yun, K. (2023). Reduksi Miskonsepsi Siswa pada Mata Pelajaran PAI di SMPN 5 Jombang. *Irsyaduna: Jurnal Studi Kemahasiswaaan*, *3*(2) 222-246. http://dx.doi.org/10.54437/irsyaduna.v3i2.1160.

Novitasari, I., & Susantini, E. (2021). Profil Miskonsepsi Siswa pada Materi Sistem Gerak Manusia Menggunakan Four-Tier True False Item Diagnostic Test. *Berkala Ilmiah Pendidikan Biologi (Bioedu)*, *10*(2) 427–434. https://ejournal.unesa.ac.id/index.php/bioedu/article/view/38578.

Onder Celikkanlı, N. U. R. A. Y., & Kızılcık, H. A. S. A. N. (2022). A Review of Studies

About Four-Tier Diagnostic Tests in Physics Education. *Journal of Turkish Science Education*, *19*(4) 1291-1311. http://dx.doi.org/10.36681/tused.2022.175.

Phipps, J. (2023). The Validation of Two L2 Self-Efficacy Instruments Using RASCH Analysis. *Research Methods in Applied Linguistics*, *2*(3) 100084. https://www.sciencedirect.com/science/article/pii/S2772766123000447.

Pakpahan, T. R., Hernawati, D., & Ardiansyah, R. (2020). Analysis of Students' Misconceptions on the Nervous System Materials Using the Four-Tier Diagnostic Test. *Bioeduscience: Jurnal Pendidikan Biologi Dan Sains*, *4*(1) 27–36. https://doi.org/10.29405/j.bes%2F4127-364844.

Rahman, Y. A. (2023). Person and Item Validity and Reliability in Essay Writing Using RASCH Model. *Konstruktivisme: Jurnal Pendidikan dan Pembelajaran*, *15*(1) 41-55. https://ejournal.unisbablitar.ac.id/index.php/konstruktivisme/article/view/2618.

Rokhim, D. A., Widarti, H. R., & Sutrisno, S. (2023). Five-Tier Diagnostic Test Instrument Validation on Reaction Rate Materials: To Identify the Causes of Misconception and Student Representation. *Jurnal Penelitian Pendidikan IPA*, *9*(3) 1380-1385. https://scholar.google.com/citations?user=sjixfuEAAAAJ&hl=id&oi=sra.

Rochma, N. A., Suwanti, V., & Pranyata, Y. I. P. (2023). Analisis Kemampuan Pemahaman Konsep Siswa dalam Menyelesaikan Masalah Perbandingan Berdasarkan Teori Pirie-Kieren. *JMPM: Jurnal Matematika dan Pendidikan Matematika*, *8*(2) 100-113. http://journal.unipdu.ac.id/index.php/jmpm/article/view/3889.

Saputra, A. Y. (2019). Identifikasi Miskonsepsi Menggunakan Certainty of Response Index (CRI) Materi Sistem Gerak Pada Siswa Kelas XI MIPA MAN 4 Bantul. *Dissertation,* UIN Sunan Kalijaga. https://digilib.uin-suka.ac.id/id/eprint/37590.

Sari, D. R. (2019). Analysis of Primary School Students'misconception Through Six Tier Diagnostic Test About the Concept of Water Characteristics. *Jurnal Dimensi Pendidikan dan Pembelajaran*, *6*(3) 113-118. http://oipas.sentraki.umpo.ac.id/index.php/dimensi/article/view/1374.

Suyono, S., Aini, K., & Sanjaya, I. G. M. (2023). The Effectiveness of The Six Tier Diagnostic Test (STDT) Instrument in Viewed from Empirical Validity to Identify Student's Misconceptions in Chemical Equilibrium Materials. *IJORER: International Journal of Recent Educational Research*, *4*(6) 827-836. https://journal.ia-education.com/index.php/ijorer/article/view/413.

Simorangkir, T. V., Zulfadli, & Ibrahim. (2020). Analisis Miskonsepsi Menggunakan Metode Certainty Of Response Index (CRI) Pada Materi Sistem Saraf Kelas XII Mia SMA Negeri 3 Tarakan Misconception Analysis Using Centainty of Response Index (CRI) on The Theme of Nerve System in XII Grade Majoring in. *Biopedagoga*, *2*(1) 15–26. http://jurnal.borneo.ac.id/index.php/biopedagogia/article/view/1710.

Sitanggang, E., & Naibaho, D. (2023). Tanggung Jawab Guru PAK Mengembangkan Spiritualitas untuk Meningkatkan Profesionalisme Keguruan. *Jurnal Pendidikan Sosial dan Humaniora*, *2*(4). 12987-12999. https://publisherqu.com/index.php/pediaqu/article/view/733.

Sumintono, B. (2014). *Aplikasi Model RASCH untuk Penelitian Ilmu-Ilmu Sosial*. Cimahi: Trim Komunikata Publishing House.

Utami, A. W., & Khotimah, S. N. (2023). Identification of Students' Misconceptions Using Six Tier Diagnostic Test with CRI (Certainty of Response Index) on Wave. *Jurnal Penelitian Pendidikan IPA*, *9*(7) 5205-5213. http://dx.doi.org/10.29303/jppipa.v9i7.4192.

Vrotsou, K., Subiza-Pérez, M., Lertxundi, A., Vergara, I., Marti-Carrera, I., de Retana, L. O., & Ibarluzea, J. (2023). Environmental Health Knowledge of Healthcare

Professionals: Instrument Development and Validation Using the RASCH Model. *Environmental Research*, *235*(116582) 1-7. https://www.sciencedirect.com/science/article/pii/S0013935123013865.

Wati, D. P., & Fatayan, A. (2023). Pengaruh Motivasi Belajar dengan Hasil Belajar Mata Pelajaran PKn Siswa Kelas V Sekolah Dasar. *Journal on Education*, *5*(2), 5193-5200. https://www.jonedu.org/index.php/joe/article/view/1082.

Zaman, T., & Bulut, H. (2023). An Efficient Family of Robust-Type Estimators for the Population Variance in Simple and Stratified Random Sampling. *Communications in Statistics-Theory and Methods*, *52*(8) 2610-2624.https://www.tandfonline.com/doi/abs/10.1080/03610926.2021.1955388