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Applying the Rasch Model to Investigate Habit of Mind Pre-service Teacher

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Abstract. The habit of mind mathematics is an intelligent behavior that affects individual success because by having this behavior students can quickly and precisely find complex solutions to mathematical problems. This study aims to identify the habit of mind of mathematics teacher candidates based on their indicators. This quantitative study applies the Rasch model with as many as 245 research subjects as prospective teacher students in the 2021/2022 academic year. Rasch analysis is used because it assumes parameter invariance, meaning that the statement item parameters do not depend on the teacher candidate's ability parameters and vice versa. The Habit of mind instrument was used in the form of a questionnaire with 7 (seven) indicators totaling 54 statements. Before the questionnaire is used, face and content validity are carried out by experts. The results of Rasch's analysis show that the habit of mind mathematics possessed by prospective teachers in each class is different. Upper-semester students have a better habit of mind than early-semester students.

Key words: Habit of mind; Rasch Model

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INTRODUCTION

The success of students in learning mathematics is influenced by various aspects, both from within and outside the student. The internal factor is the mathematical habit of mind. The habit of mind or habit of thinking is to have an intelligent, successful, skilled, and patient character when faced with unclear problems. (Anderson 2020) Someone successful and intelligent shows good development in terms of mature habits of thought. Furthermore, the habit of thinking is also defined as knowledge of how to behave intelligently when not knowing the answer, which means having a disposition towards intelligent behavior when facing problems, the answers of which are not immediately known. (Cooper and Jenson 2009) Resnick further stated that a person's intelligence is the result of the sum of his habits of mind. (Resnick and Resnick 1977).

Thinking is a dynamic process and not static (Kucyi 2018). To be able to develop a habit of mind requires a stimulus in the form of thinking exercises. The form of thinking exercises that can be done is to find solutions to problems that start with simple things to more complex ones. Exercises and real problems will provide opportunities for students to think about alternative solutions to problems (Dwijayanti 2019). Problems that can be used as a stimulus range from simple and concrete numbers to logical problems and formal variables. Starting from inductive thinking to deductive thinking (Schuck and Brandenburg 2019).

Habits that have been carried out for a long time sometimes make a person unable to develop his thinking. One way to change this is by doing a new activity. For example, by looking for new challenges that encourage you to be able to think outside the box. So, the habit of thinking can be trained and produce a new activity in the habit of thinking. Learning is not just a transfer of knowledge but to instill the habit of thinking (Kurniasih 2017).

Students of the Mathematics Education study program as future mathematics teachers should have a good habit of mind which will later be used as capital to transfer knowledge and make students understand about mathematical knowledge as a provision for students to solve problems. The most effective students have developed strong thinking habits that enable them to think critically, think creatively, and regulate their own behavior. (Marzano et al. 2006).

With regard to thinking habits, Costa and Kallick identified 16 (sixteen) characteristics that arise when a person is faced with a problem whose solution is not immediately known, namely 1) persisting, 2) managing impuisivity, 3) listening with understanding and empathy, 4) thinking flexibly, 5) metacognition, 6) striving for accuracy, 7) questioning and problem posing, 8) applying past knowledge to new situations, 9) thinking and communicating with crarity and precision, 10) gathering data through all sense,

11) creating, imagining and innovating, 12) responding with wonderment and awe, 13) taking responsible risk, 14) finding humor, 15) thinking interdependently, and 16) remaining open to continuous learning (Campbell 2006). The sixteen characteristics of habitual thinking identified by Costa and Kallick were further synthesized by Marzano and Pickering into three categories, namely: (1) Self-regulation, (2) Critical thinking, and (3) Creative thinking (Marzano et al. 2006).

Based on the description above, a study is needed to investigate how the habit of mind of prospective teacher students of different levels and genders is based on habit of mind indicators.

METHOD

This research using RASCH modeling was conducted on students of the Mathematics Education study program enrolled in the 2021-2022 academic year. The subjects of this study amounted to 245 participants who came from students from the beginning to the end.

The research instrument used was a questionnaire about the habit of mind of future mathematics teachers which contained 54 question items with five answer choices. The five answer choices are Strongly Agree (SS), Agree (S), Less Agree (KS), Disagree (TS), and Strongly Disagree (STS) with points for negative statements from 5 – 1 and positive statements 1 – 5 This questionnaire uses habit of mind indicators. The habit of mind indicators in this study are divided into 7 (seven) indicators, namely 1) persisting (A), 2) managing impuisivity (B), 3) thinking flexibly (C), 4) metacognition (D), 5) applying past knowledge to new situations (E), 6) remaining open to continuous learning (F), and 7) thinking interdependently (G). With the following distribution:

Table 1. Distribution of Indicators and Habit of Mind questionnaire items

No	Indicator	Statement Items
1	Persisting (A)	8
2	Managing impuisivity (B)	6
3	Thinking flexibly (C)	8
4	Metacognition (D)	9
5	Applying past knowledge to new situations (E)	9
6	Remaining open to continuous learning (F)	6
7	Thinking interdependently (G)	8
Total		54

The concept of objective measurement in educational assessment must have five criteria, including 1) Providing a linear measure at equal intervals, 2) carrying out an appropriate estimation process, 3) determining items that are inappropriate (misfits) or unusual (outliers), 4) overcoming missing data, 5) producing measurements that are independent of the parameters studied (replicable). Of these five conditions, only the RASCH model can fulfill them (Sumintono and Widhiarso 2015).

The data that has been collected is then analyzed using the RASCH modeling using the WINSTEPS software. Habit of mind questionnaire data for prospective teacher students is tabulated in Microsoft Excel software to prepare data files, namely pnr type files that can be read through the notepad program. The data analysis process then prepares the data format in the Ministep program to do RASCH modeling. The results of this research data analysis using the RASCH model are carried out with several things, namely:

1) Analysis of the Wright Map, which is a map that describes the distribution of students' habit of mind and items that are difficult to agree with on the same scale;
2) Analysis of item items which include item measure, item fit (level of item suitability), and detection of biased items;
3) Analysis of student capabilities which includes pearson meanure and person fit (level of individual suitability);
4) Instrumental analysis, namely a comprehensive analysis with the RASCH model as a whole with more detail in the form of statistical summaries and test information functions that will guide researchers in making logical, precise and scientific decisions (Kurniasih 2020).

RESULTS AND DISCUSSION

3.1 Variable Maps Analysis

Habit of mind analysis of prospective teacher

students consisting of 245 respondents using the RASCH model in a comprehensive manner can be seen in the Variable Maps. The Wright Map on the left illustrates the distribution of student abilities explaining the level of habit of mind of all students answering all of the item questions given.

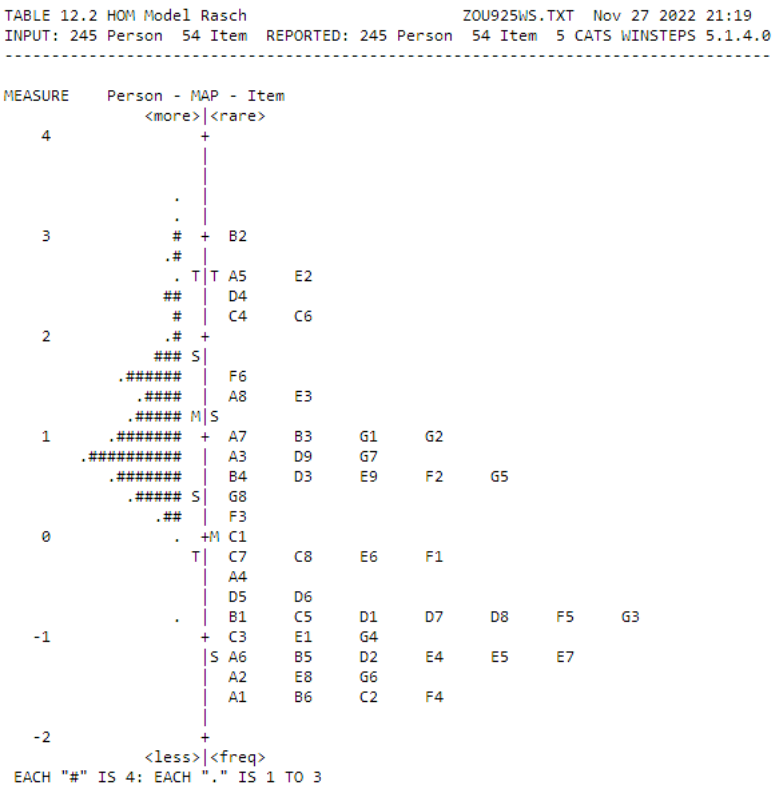


Figure 1. Variabel Maps

From Figure 1 it can be seen that the distance between T - S - M illustrates disagreement (difficult to accept) on various statement items owned by 54 statement items, namely from items that are most agreed on to items that are difficult to agree on, namely B2 (second statement on the second indicator, namely managing impuisivity) to C2 (the second statement on the first indicator, namely thinking flexibly). This shows that in item B2 statement, namely "I have a flexible/erratic study schedule", many students disagree. So in this statement item many students feel they have an inflexible study schedule.

Whereas in the statement item C2 namely "I openly accept suggestions from friends" this was widely agreed upon by students. This is good because one of the keys to the habit of mind is openness in receiving suggestions and input from friends. The difference in the various distances between the question items indicates the statement items used to measure the habit of mind of prospective teacher students provide useful information about the level of habit of mind of students. The T – S – M distance on the Map Variable also states that the distribution of student abilities is wider than the distribution of student disagreement items on the given statement items. This shows that the habit of mind of prospective teacher students has a level that is not too different.

Furthermore, in order to see the misfit of items is to use the Expected Score ICC chart (Sumintono and Widhiarso 2015) as in the following picture:

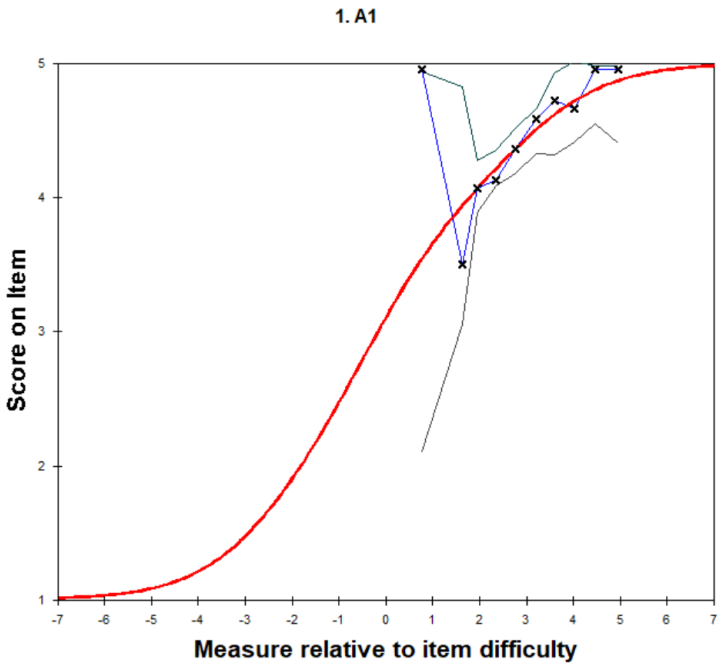


Figure 2. Expected Score ICC

Figure 2 shows the red line showing the ideal model curve and the confidence space curve (gray on the top and bottom sides), the misfit response will be outside the confidence space curve. Figure 2 shows all the responses to the items, there is no misfit or the respondents are consistent in answering each statement on the item.

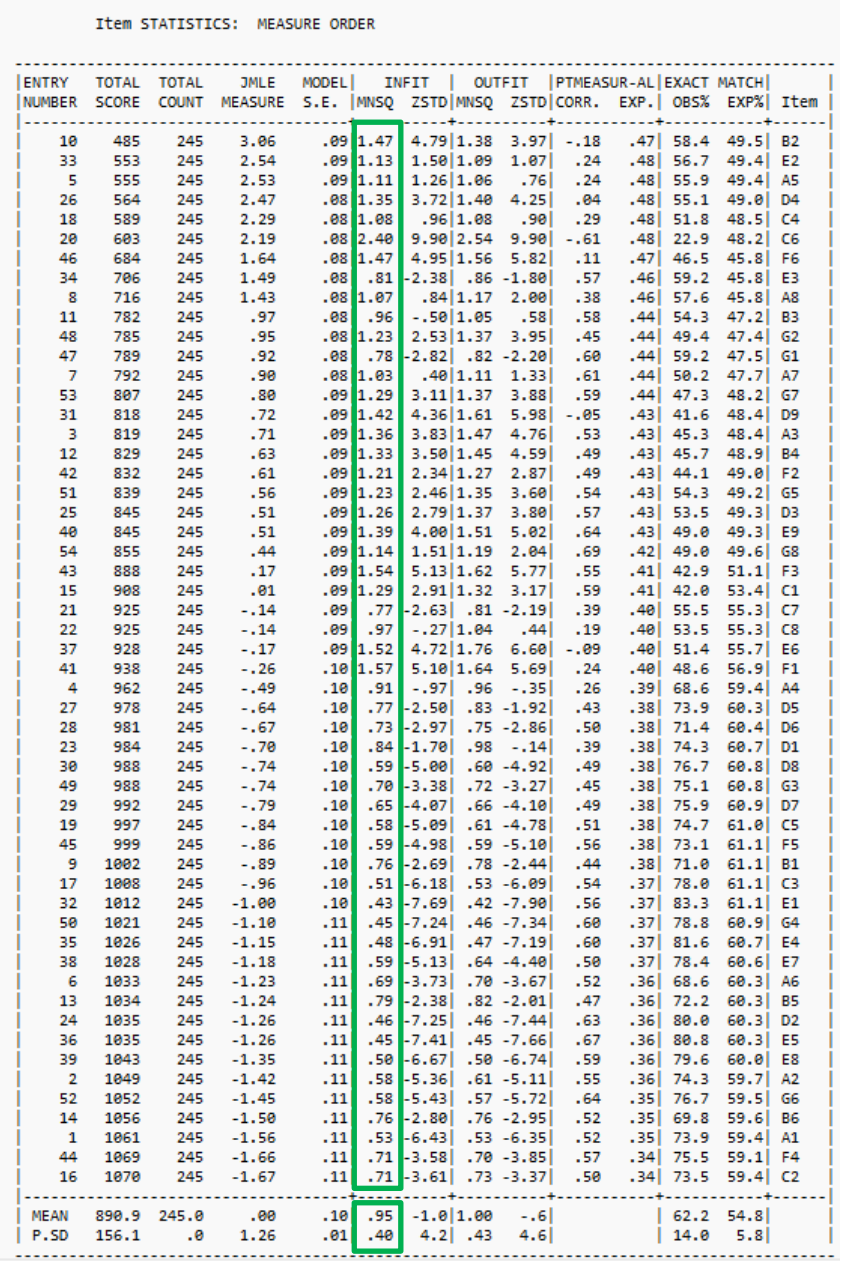
3.2 Item Analysis

The analysis of the items carried out consisted of item means, item fit (level of item suitability), and detection of biased items. Item meansure, conveying information about which items are most approved and which items are least approved. Items that are the easiest to agree with and are not approved by respondents can be seen from the logit value in the meansure column, which is marked with the highest logit value, which means it is difficult to agree to the lowest, the easiest to approve.

On the habit of mind scale which can be seen in Figure 3, the item that was the most difficult to agree with 245 respondents was item B2 with the highest item logit value of the other logit values (+1.47). Then the item that is most easily approved by respondents in the habit of mind instrument is item C2 (+0.71). The Total Count table provides information about whether or not the data obtained from the respondents is complete or not in each item. It is known that from the Total Count column all items show the number 245 meaning that all respondents filled in the 54 items given. This means that no data is lost (empty)

The item analysis shows fit order items from the habit of mind questionnaire. To find out which items do not fit, you can identify them by adding up the logit items (Mean infit MNSQ) with the average value at the standard deviation (infit MNSQ S.D) (Sumintono and Widhiarso 2015). On the habit of mind scale, the Mean infit MNSQ value is (0.95 + 0.40) = + 1.35, so this criterion contains nine items with a greater MBSQ infit value, namely B2 (+1.47), C6 (+2, 40), F6 (+1.47), D9 (+1.42), A3 (+1.36), E9 (+1.39), F3 (+1.54), E6 (+1.52) , and F1 (+1.57). This means that 9 (nine) items that have a value greater than the MNSQ infit criteria indicate that the item is misfit.

From the results of the fit order items, not only information about fit and misfit items is obtained, but it can also be seen that items have the same logit value and come from the same aspects, namely C5 (+0.58), A2 (+0.58) and G6 (+0.58) as well as F4 (+0.71) and C2 (+0.71).



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
10	485	245	3.06	.09	1.47	4.79	1.38	3.97	-.18	.47	58.4	49.5	B2
33	553	245	2.54	.09	1.13	1.50	1.09	1.07	.24	.48	56.7	49.4	E2
5	555	245	2.53	.09	1.11	1.26	1.06	.76	.24	.48	55.9	49.4	A5
26	564	245	2.47	.08	1.35	3.72	1.40	4.25	.04	.48	55.1	49.0	D4
18	589	245	2.29	.08	1.08	.96	1.08	.90	.29	.48	51.8	48.5	C4
20	603	245	2.19	.08	2.40	9.90	2.54	9.90	-.61	.48	22.9	48.2	C6
46	684	245	1.64	.08	1.47	4.95	1.56	5.82	.11	.47	46.5	45.8	F6
34	706	245	1.49	.08	.81	-2.38	.86	-1.80	.57	.46	59.2	45.8	E3
8	716	245	1.43	.08	1.07	.84	1.17	2.00	.38	.46	57.6	45.8	A8
11	782	245	.97	.08	.96	-.50	1.05	.58	.58	.44	54.3	47.2	B3
48	785	245	.95	.08	1.23	2.53	1.37	3.95	.45	.44	49.4	47.4	G2
47	789	245	.92	.08	.78	-2.82	.82	-2.20	.60	.44	59.2	47.5	G1
7	792	245	.90	.08	1.03	.40	1.11	1.33	.61	.44	50.2	47.7	A7
53	807	245	.80	.09	1.29	3.11	1.37	3.88	.59	.44	47.3	48.2	G7
31	818	245	.72	.09	1.42	4.36	1.61	5.98	-.05	.43	41.6	48.4	D9
3	819	245	.71	.09	1.36	3.83	1.47	4.76	.53	.43	45.3	48.4	A3
12	829	245	.63	.09	1.33	3.50	1.45	4.59	.49	.43	45.7	48.9	B4
42	832	245	.61	.09	1.21	2.34	1.27	2.87	.49	.43	44.1	49.0	F2
51	839	245	.56	.09	1.23	2.46	1.35	3.60	.54	.43	54.3	49.2	G5
25	845	245	.51	.09	1.26	2.79	1.37	3.80	.57	.43	53.5	49.3	D3
40	845	245	.51	.09	1.39	4.00	1.51	5.02	.64	.43	49.0	49.3	E9
54	855	245	.44	.09	1.14	1.51	1.19	2.04	.69	.42	49.0	49.6	G8
43	888	245	.17	.09	1.54	5.13	1.62	5.77	.55	.41	42.9	51.1	F3
15	908	245	.01	.09	1.29	2.91	1.32	3.17	.59	.41	42.0	53.4	C1
21	925	245	-.14	.09	.77	-2.63	.81	-2.19	.39	.40	55.5	55.3	C7
22	925	245	-.14	.09	.97	-.27	1.04	.44	.19	.40	53.5	55.3	C8
37	928	245	-.17	.09	1.52	4.72	1.76	6.60	-.09	.40	51.4	55.7	E6
41	938	245	-.26	.10	1.57	5.10	1.64	5.69	.24	.40	48.6	56.9	F1
4	962	245	-.49	.10	.91	-.97	.96	-.35	.26	.39	68.6	59.4	A4
27	978	245	-.64	.10	.77	-2.50	.83	-1.92	.43	.38	73.9	60.3	D5
28	981	245	-.67	.10	.73	-2.97	.75	-2.86	.50	.38	71.4	60.4	D6
23	984	245	-.70	.10	.84	-1.70	.98	-.14	.39	.38	74.3	60.7	D1
30	988	245	-.74	.10	.59	-5.00	.60	-4.92	.49	.38	76.7	60.8	D8
49	988	245	-.74	.10	.70	-3.38	.72	-3.27	.45	.38	75.1	60.8	G3
29	992	245	-.79	.10	.65	-4.07	.66	-4.10	.49	.38	75.9	60.9	D7
19	997	245	-.84	.10	.58	-5.09	.61	-4.78	.51	.38	74.7	61.0	C5
45	999	245	-.86	.10	.59	-4.98	.59	-5.10	.56	.38	73.1	61.1	F5
9	1002	245	-.89	.10	.76	-2.69	.78	-2.44	.44	.38	71.0	61.1	B1
17	1008	245	-.96	.10	.51	-6.18	.53	-6.09	.54	.37	78.0	61.1	C3
32	1012	245	-1.00	.10	.43	-7.69	.42	-7.90	.56	.37	83.3	61.1	E1
50	1021	245	-1.10	.11	.45	-7.24	.46	-7.34	.60	.37	78.8	60.9	G4
35	1026	245	-1.15	.11	.48	-6.91	.47	-7.19	.60	.37	81.6	60.7	E4
38	1028	245	-1.18	.11	.59	-5.13	.64	-4.40	.50	.37	78.4	60.6	E7
6	1033	245	-1.23	.11	.69	-3.73	.70	-3.67	.52	.36	68.6	60.3	A6
13	1034	245	-1.24	.11	.79	-2.38	.82	-2.01	.47	.36	72.2	60.3	B5
24	1035	245	-1.26	.11	.46	-7.25	.46	-7.44	.63	.36	80.0	60.3	D2
36	1035	245	-1.26	.11	.45	-7.41	.45	-7.66	.67	.36	80.8	60.3	E5
39	1043	245	-1.35	.11	.50	-6.67	.50	-6.74	.59	.36	79.6	60.0	E8
2	1049	245	-1.42	.11	.58	-5.36	.61	-5.11	.55	.36	74.3	59.7	A2
52	1052	245	-1.45	.11	.58	-5.43	.57	-5.72	.64	.35	76.7	59.5	G6
14	1056	245	-1.50	.11	.76	-2.80	.76	-2.95	.52	.35	69.8	59.6	B6
1	1061	245	-1.56	.11	.53	-6.43	.53	-6.35	.52	.35	73.9	59.4	A1
44	1069	245	-1.66	.11	.71	-3.58	.70	-3.85	.57	.34	75.5	59.1	F4
16	1070	245	-1.67	.11	.71	-3.61	.73	-3.37	.50	.34	73.5	59.4	C2
MEAN	890.9	245.0	.00	.10	.95	-1.0	1.00	-.6			62.2	54.8	
P.SD	156.1	.0	1.26	.01	.40	4.2	.43	4.6			14.0	5.8	

Figure 3. Meansure Order

3.3 Pre-Service Student Ability Analysis

Student ability analysis is used to identify students who have different response patterns (eg careless and lucky guess) or students who are identified as collaborating. Figure 4 shows data about the habit of mind of prospective teacher students through detailed log information from each individual.

In the summary of personal response patterns, the value of the infit and outfit mean square is close to a perfect score (1.0). The person reliability value also shows satisfactory reliability (0.88). The value of separation is 2.74 (rounded to 3). The value of the person strata that has a value of 3 identifies a group of respondents. This shows that the representativeness of students who filled out the habit of mind questionnaire had a mean value (logit) of 243 while the lowest was 143.

```
TABLE 3.1 C:\Users\Admin17\Desktop\ARTIKEL_ISET. ZOU588WS.TXT  Sep  8 2022 10:40
INPUT: 245 Person  54 Item  REPORTED: 245 Person  54 Item  5 CATS WINSTEPS 5.1.4.0
-------------------------------------------------------------------------------

     SUMMARY OF 245 MEASURED Person
-------------------------------------------------------------------------------
|          TOTAL                    MODEL        INFIT        OUTFIT          |
|          SCORE     COUNT     MEASURE   S.E.     MNSQ   ZSTD   MNSQ   ZSTD  |
|------------------------------------------------------------------------------|
| MEAN     196.4      54.0        1.16     .20     1.07   -.50   1.00   -.74  |
|  SEM       1.1        .0         .04     .00      .06    .23    .05    .22  |
| P.SD      16.5        .0         .69     .01      .88   3.56    .79   3.43  |
| S.SD      16.5        .0         .70     .01      .88   3.57    .79   3.43  |
| MAX.     243.0      54.0        3.43     .26     6.44   9.91   6.72   9.91  |
| MIN.     143.0      54.0        -.79     .18      .15  -7.14    .14  -7.32  |
|------------------------------------------------------------------------------|
| REAL RMSE    .24 TRUE SD     .65  SEPARATION  2.74  Person RELIABILITY  .88  |
|MODEL RMSE    .20 TRUE SD     .66  SEPARATION  3.28  Person RELIABILITY  .92  |
| S.E. OF Person MEAN = .04                                                    |
-------------------------------------------------------------------------------
Person RAW SCORE-TO-MEASURE CORRELATION = 1.00 (approximate due to missing data)
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .91  SEM = 5.03 (approximate due to missing data)
STANDARDIZED (50 ITEM) RELIABILITY = .91
```

Figure 4. Summary of Meansure Person

3.4 Instrument Analysis

The final stage in the Rasch modeling analysis is instrument analysis. This is done as a whole which provides information about the quality of student teacher response patterns, the quality of the instruments and the interactions between persons and items.

Figure 4 shows that the person means value is 1.16 logit, showing the average score of 245 student teacher candidates answering the habit of mind statement items given. Whereas in Figure 5, the average student ability score is less than the 0.00 logit meanure item which states that the habit of mind possessed by students is greater than the level of approval of the items given.

```
     SUMMARY OF 54 MEASURED Item
-------------------------------------------------------------------------------
|          TOTAL                    MODEL        INFIT        OUTFIT          |
|          SCORE     COUNT     MEASURE   S.E.     MNSQ   ZSTD   MNSQ   ZSTD  |
|------------------------------------------------------------------------------|
| MEAN     890.9     245.0         .00     .10      .95   -.98   1.00   -.58  |
|  SEM      21.4       .0         .17     .00      .05    .58    .06    .63  |
| P.SD     156.1       .0        1.26     .01      .40   4.25    .43   4.55  |
| S.SD     157.5       .0        1.28     .01      .40   4.29    .44   4.59  |
| MAX.    1070.0     245.0        3.06     .11     2.40   9.90   2.54   9.90  |
| MIN.     485.0     245.0       -1.67     .08      .43  -7.69    .42  -7.90  |
|------------------------------------------------------------------------------|
| REAL RMSE    .10 TRUE SD    1.26  SEPARATION 12.36  Item   RELIABILITY  .99  |
|MODEL RMSE    .10 TRUE SD    1.26  SEPARATION 13.09  Item   RELIABILITY  .99  |
| S.E. OF Item MEAN = .17                                                      |
-------------------------------------------------------------------------------
```

Figure 5. Summary of Meansure Ittem

Furthermore, the Person reliability value is 0.88 and the item reliability value is 0.99, this means that the level of consistency is weak. However, the quality of the statement items of the student's habit of mind according to the level of acceptance is weak, but the quality of the statement items used as an instrument for collecting data regarding the habit of mind of students is special. Cronbach's alpha value of 0.91 stated that the interaction between the students' habit of mind and the statement items as a whole was very good.

CONCLUSION

The results of the analysis found that the item reliability index value was 0.99 and the person reliability index was 0.88. Very good interaction occurs between person and item as indicated by the Cronbach alpha index value of 0.91. Representative abilities of students who filled out the Habit of Mind questionnaire had a meanure (logit) score of 243 while the lowest was 143.

REFERENCES

Anderson, James. 2020. "Sukses Dengan Kebiasaan Pikiran | Kebiasaan Pikiran." Retrieved October 6, 2022 (https://habitsofmind.org/succeeding-with-habits-of-mind/).

Campbell, J. 2006. "Theorising Habits of Mind as a

Framework for Learning." *Australian Association for Research in Education Conference* 1–21.

Cooper, Alan, and Georgetta Jenson. 2009. *Habit of Mind Across the Curriculum: Proactical Processes for Teaching Habits of Mind*. edited by A. L. Costa and B. Kallick. Association for Supervision and Curriculum Development.

Dwijayanti, M. N. 2019. "Development of Circle Learning Media to Improve Student Learning Outcomes." *Journal of Physics: Conference Series* 1321. doi: 10.1088/1742-6596/1321/2/022099.

Kucyi, Aaron. 2018. "Just a Thought: How Mind-Wandering Is Represented in Dynamic Brain Connectivity." *NeuroImage* 180:505–14. doi: 10.1016/J.NEUROIMAGE.2017.07.001.

Kurniasih, M. D. 2017. "Pengaruh Pembelajaran React Terhadap Kemampuan Berpikir Kritis Matematis Ditinjau Dari Habit Of Mind." *KALAMATIKA Jurnal Pendidikan Matematika* 2(1).

Kurniasih, Meyta Dwi. 2020. "Analisis Habit of Mind Mahasiswa Calon Guru Dengan Pemodelan RASCH." *Seminar Nasional Pascasarjana 2020* 221–29.

Marzano, Robert J., Debra J. Pickering, Daisy E. Arredondo, Guy J. Blackburn, Ronald S. Brandt, Cerylle A. Moffett, Diane E. Paynter, Jane E. Pollock, and Jo Sue Whisler. 2006. "D i m e n s i o n s o f L e a r n i n G." *Teachers Manual* 2nd Editio(Hawker Brownlow Education):1–12.

Resnick, D., and L. Resnick. 1977. "The Nature of Literacy: An Historical Exploration." *Harvard Educational Review*.

Schuck, Sandy, and Robyn Brandenburg. 2019. "Self-Study in Mathematics Teacher Education." (1987):1–29. doi: 10.1007/978-981-13-1710-1_29-1.

Sumintono, Bambang, and Wahyu Widhiarso. 2015. *Aplikasi Pemodelan Rasch Pada Assessment Pendidikan*. Cimahi: Trim Komunikata.