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Article

Validity and Reliability of Islamic and Indonesian-based Contextual Science Literacy Assessment Instruments

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ABSTRACT

This study aims to determine the validity of the Islamic and Indonesian-based contextual scientific literacy assessment instrument (ALSKII) using the Rasch model. This instrument was developed in the context of Covid-19 as a socio-scientific issue that is presented in a structured manner with a plural model, namely scientific and socio-scientific. The scientific model represents the content of science which is presented in three models, namely mechanistic, systematic, and mathematical. The socio-scientific model is a scientific context that is integrated with religion and nation. This instrument has five skills which are made into 25 question items. The sample of this research is 75 final-semester science education students who were selected purposively. The results showed that the Islamic and Indonesian-based contextual scientific literacy assessment instrument was valid and reliable with a person measure the value of 0.73, MNSQ person and item close to 0.0, person and ZSTD item close to 1.0, Cronbach alpha 0.67, person reliability 0.64 and item reliability 0.95. This instrument can be an alternative in the assessment of scientific literacy based on religion and the state. The instrument can also be further developed according to the context and socio-scientific issues that need to be solved in the community.

INTRODUCTION

The Organization defines scientific literacy as the ability to use natural science to identify problems and draw conclusions based on evidence for the purpose of understanding and helping make decisions about the environment and change through human activities (OECD, 2014). The COVID-19 pandemic, which is still ongoing and is not certain when it will end, increasingly requires mastery of scientific literacy for students. COVID-19 represents a current socio-scientific issue with many different aspects and social impacts. Socio-scientific issues (SSIs) are socially significant, real-world issues, culturally important and based on science(Tyrrell & Calinger, 2021). Socio-scientific issues (SSIs) are also complex, controversial, and dilemmatic issues, and have a major impact on society (Issaev & Shishkina, 2019; Kahn, 2015; Nida et al., 2021; Puig et al., 2021; Qayum et al., 2015; Tyrrell & Calinger,

2021). Therefore, the completion of SSIs requires the contribution of the role of various sciences in an interdisciplinary manner(Dauer et al., 2021; Kahn, 2015; Songer & Recalde, 2021; Sutter et al., 2018). Problem-solving SSIs consider difficult science problems because they require evidence-based reasoning. Therefore, SSIs-based lectures can help students become well-literate citizens of science(Herman et al., 2021; Newton & Zeidler, 2020; Zeidler & Kahn, 2014).

According to Zeidler (2014), the application of scientific understanding in personal and community contexts in everyday life needs to emphasize the interdisciplinary relationship between science, language arts and mathematics.(Zeidler & Kahn, 2014). The learning process of Natural Sciences (IPA) can be a means of self-learning and the environment(Zeidler & Kahn, 2014). Thus, socio-scientific issues (SSI) become a good medium for Science Education students to practice contextual-interdisciplinary scientific literacy skills. This is important because prospective science teachers need to be equipped with an approach that places science in a meaningful context for students' lives and requires students to consider the moral and ethical implications of their decisions.(Zeidler & Kahn, 2014). The way students learn science will affect their level of scientific literacy. If students experience what they have learned rather than what they have learned, then learning will be more meaningful. Therefore, learning through contextual scientific literacy assessment helps connect the material taught to the real world, and can train students to make connections between knowledge and its application in the lives of family members and society.(Ambarwati et al., 2016).This study aims to determine the validity and reliability of the ALSKII instrument based on the Rasch model.

METHODS

Respondents

Respondents in this study were 75 final-semester students in the science education study program. The respondents came from two State Islamic Religious Universities in Central Java Province, namely the Salatiga State Islamic Institute and the Tulungagung State Islamic Institute. Final semester students were chosen as respondents because they had completed all the basics of Islam and Indonesianness as well as basic and advanced science courses. Respondents who have mastered all of these courses are expected to be able to implement their knowledge contextually in an effort to obtain solutions to socio-scientific problems.

Instrument

The ALSKII instrument that had been developed was then revised based on input from validators, peer reviewers, and students. The revised ALSKII instrument was then tested on final-semester student respondents to determine its feasibility. The ALSKII instrument consists of 25 multiple-choice questions that are used to determine 5 types of scientific and socio-scientific literacy skills. Data collection was carried out through Google Forms to facilitate student access during the Covid-19 pandemic.

Data Analysis

The quality of the assessment instrument can be known from its validity and reliability(Ramdani et al., 2020). The validity and reliability of the ALSKII instrument were analyzed using the item response test (IRT) with the Rasch model(Osterlind & Wang, 2018)using the Ministep evaluation/student version of the Winsteps 5.1.6.0 application. IRT was chosen because of its advantages in analyzing the quality of the instrument which does not depend on the ability of the testee but is based on the logit value that reflects the probability of selecting an item in a group of testees.(Mehren et al., 2018; Osterlind & Wang, 2018; Paxinou et al., 2017).

Instrument reliability

Analysis of the reliability of the ALSKII instrument was carried out through the output table Summary statistics. The instrument is declared reliable if the person measures value shows a

number greater than the logit value of 0.0. The average value that is greater than the logit indicates a tendency for the testee's ability to be higher than the level of difficulty of the questions. This means that the testee tends to be able to correctly answer the questions contained in the instrument. Cronbach's alpha values are interpreted based on Table 1.

Table 1. Interpretation of Instrument Reliability based on Cronbach Alpha

Value	Interpretation
$\alpha > 0,8$	Very good
$0,7 < \alpha \leq 0,8$	Good
$0,6 < \alpha \leq 0,7$	Enough
$0,5 < \alpha \leq 0,6$	Bad
$\alpha \leq 0,5$	Very bad

The interpretation of the value of person reliability and item reliability is shown in Table 2.

Table 2. Interpretation of the value of person reliability and item reliability

Value	Interpretation
> 0,94	Special
0,91 – 0,94	Very good
0,81 – 0,90	Good
0,67 – 0,80	Enough
≤ 0,67	Weak

The ideal value of INFIT MNSQ and OUTFIT MNSQ is 1.00. If the value is closer to 1.00 then the quality of the instrument is getting better. While the ideal value for INFIT ZSTD and OUTFIT ZSTD is 0.00. This means that a good quality instrument has an INFIT ZSTD value and an OUTFIT ZSTD value close to 0.00. The quality of the instrument can also be known from the separation value. The greater the value of the separation testee and item, the better the quality of the instrument(Sumintono & Widhiarso, 2013).

Instrument validity

Validity is the ability of a measuring instrument to be measured(Sadhu & Laksono, 2018). The validity test using the Rasch model is known as the unidimensionality test(Sumintono & Widhiarso, 2013). The unidimensionality test was analyzed using the principal component (PCA) of the standardized variance in Eigenvalue units(Sumintono & Widhiarso, 2013). The validity of the instrument is interpreted based on the value of the raw variance explained by measures, it is stated to meet if > 20%, good if > 40%, and special if > 60%(Kaldaras et al., 2021; Sumintono & Widhiarso, 2013). The Rasch model also presents data analysis regarding problematic items from the eigenvalues and observed in unexplained variance 1st contrast. If the eigenvalue is less than 3, it means that there are no problematic items. The observed value is less than 15% indicating the appropriate item (item fit)(Osterlind & Wang, 2018; Sumintono & Widhiarso, 2013). According to Baghaei & Aryadoust (2015) the value of unexplained variance in the first construct residual PCA is weak if > 15%, sufficient if 10-15%, strong if 5-10%, very strong if 3-5%, and special if less than 3%(Baghaei & Aryadoust, 2015). Item fit shows that the items are able to measure what they want to measure. Item fit was analyzed based on the value of outfit means-square, outfit z-standard, and point measure correlation with the criteria as presented in Table 3 (Osterlind & Wang, 2018; Ramdani et al., 2020; Sadhu & Laksono, 2018; Sumintono & Widhiarso, 2013).

Table 3. Criteria item fit

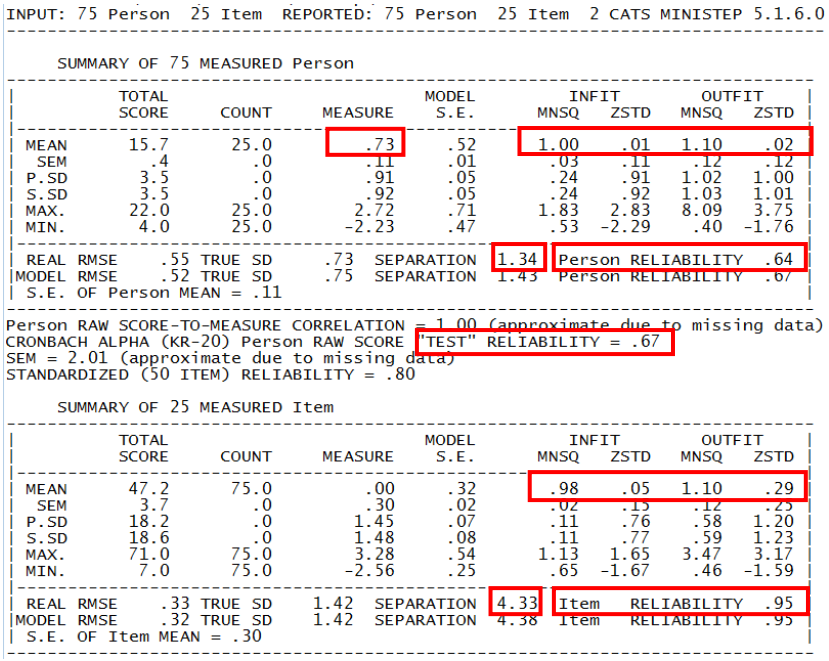
Criteria	Score
Outfit mean square (MNSQ)	0,5 < MNSQ < 1,5
Outfit Z-standard (ZSTD)	-2,0 < ZSTD < +2,0
Point Measure Correlations (Pt Measure Corr.	0,4 < Pt Measure Corr < 0,55

Based on Table 3, if the three criteria are met, it can be stated that the items are fit (item fit), and have good quality so that they are suitable for use. If the item only meets two or one criteria, it is stated that the item is not suitable so it needs to be revised or replaced(Osterlind & Wang, 2018; Sadhu & Laksono, 2018; Sumintono & Widhiarso, 2013).

RESULTS AND DISCUSSION

Output Summary Statistics (3.1)

The results of the ALSKII trial data analysis using the Ministep evaluation/student version of Winsteps 5.1.6.0 application in the form of output summary statistics (3.1) are shown in Figure 1.



```
INPUT: 75 Person  25 Item  REPORTED: 75 Person  25 Item  2 CATS MINISTEP 5.1.6.0
-------------------------------------------------------------------------------

     SUMMARY OF 75 MEASURED Person
-------------------------------------------------------------------------------
|           TOTAL                          MODEL          INFIT        OUTFIT    |
|           SCORE     COUNT     MEASURE    S.E.       MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN       15.7      25.0         .73     .52       1.00    .01   1.10    .02 |
|  SEM         .4       .0         .11     .01        .03    .11    .12    .12 |
| P.SD        3.5       .0         .91     .05        .24    .91   1.02   1.00 |
| S.SD        3.5       .0         .92     .05        .24    .92   1.03   1.01 |
| MAX.       22.0      25.0        2.72     .71       1.83   2.83   8.09   3.75 |
| MIN.        4.0      25.0       -2.23     .47        .53  -2.29    .40  -1.76 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .55 TRUE SD     .73  SEPARATION  1.34  Person RELIABILITY  .64 |
|MODEL RMSE    .52 TRUE SD     .75  SEPARATION  1.43  Person RELIABILITY  .67 |
| S.E. OF Person MEAN = .11                                                   |
-------------------------------------------------------------------------------
Person RAW SCORE-TO-MEASURE CORRELATION = 1.00 (approximate due to missing data)
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .67
SEM = 2.01 (approximate due to missing data)
STANDARDIZED (50 ITEM) RELIABILITY = .80

     SUMMARY OF 25 MEASURED Item
-------------------------------------------------------------------------------
|           TOTAL                          MODEL          INFIT        OUTFIT    |
|           SCORE     COUNT     MEASURE    S.E.       MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN       47.2      75.0         .00     .32        .98    .05   1.10    .29 |
|  SEM         .7       .0         .30     .02        .02    .13    .12    .25 |
| P.SD        1.8       .0        1.45     .07        .11    .76    .58   1.20 |
| S.SD        1.8       .0        1.48     .08        .11    .77    .59   1.23 |
| MAX.       71.0      75.0        3.28     .54       1.13   1.65   3.47   3.17 |
| MIN.        7.0      75.0       -2.56     .25        .65  -1.67    .46  -1.59 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .33 TRUE SD     1.42  SEPARATION  4.33  Item   RELIABILITY  .95 |
|MODEL RMSE    .32 TRUE SD     1.42  SEPARATION  4.38  Item   RELIABILITY  .95 |
| S.E. OF Item MEAN = .30                                                     |
-------------------------------------------------------------------------------
```

Figure 1. Output Summary Statistics

In this study, the reliability of the ALSKII instrument is shown in Figure 1. Reliability is the constancy of the instrument in assessing what is being assessed. An instrument is said to be reliable if the results are relatively the same/stable(Sumintono & Widhiarso, 2013).

The output summary statistics of the ALSKII instrument in Figure 1 show that

1. Person measure, the output above the person measure value shows 0.73 because the value is greater than logit 0.0. The average value that is greater than the logit indicates the tendency of the respondent's ability to be greater than the level of difficulty of the question or the respondent tends to be able to respond to the statements contained in the instrument.

2. Cronbach's alpha value in Figure 1 with the item Cronbach's alpha value shows 0.67 measuring the reliability of the interaction between respondents. This score can be interpreted according to Table 2 which is in the range of $0.6 < \alpha \leq 0.7$ the criteria include "Enough". Thus, the ALSKII instrument used can be declared reliable.

3. The value of Person Reliability and Item Reliability, in the output above the values both show 0.64 and 0.95. This value can be interpreted based on Table 3. Person Reliability value < 0.67 indicates that the consistency of answers from respondents is said to be "Weak". While the Item Reliability value > 0.94 indicates a "special" value criterion so that it can be stated that the quality of the items used in the instrument is very reliable.

4. The value of INFIT MNSQ and OUTFIT MNSQ, as well as INFIT ZSTD and OUTFIT ZSTD, both of which can be seen in the Person and Item table as follows: INFIT MNSQ has a person value of 1.00 and an item value of 0.98, OUTFIT MNSQ has a person value of 1.10 and an item value of 1.10, it can be seen that The values shown in the table of persons and items of

INFIT MNSQ and OUTFIT MNSQ are all closer to the value of 1.00, because the closer the data is to the value of 1.00, the better the quality is declared. then for INFIT ZSTD the person value is 0.01 and the item value is 0.05, and OUTFIT ZSTD the person value is 0.02 and the item value is 0.29. This value is close to the ideal value of 0.0, which means that the closer to the ideal value, the better the quality.

5. The grouping of persons and items can be seen from the separation value. The greater the value of separation, the quality of the instrument in terms of overall respondents and items is better because it can identify groups of respondents and groups of items. For the separation person the score in Figure 1. is 1.34 and the score for the separation item is 4.33.

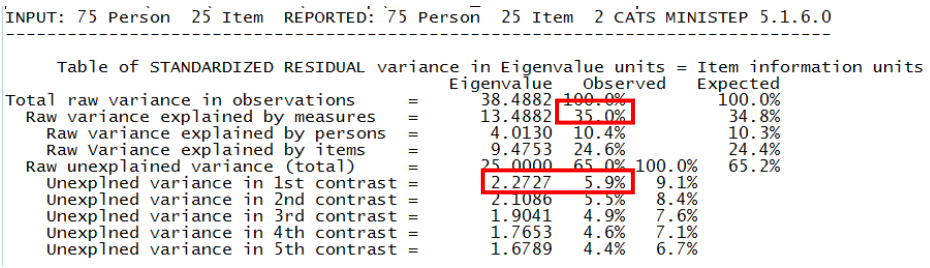
The results of the analysis of the reliability test of the ALSKII instrument are described in Table 4.

Table 4. The results of the analysis of the reliability test of the ALSKII instrument

Cronbach Alpha	Criteria	Item Reliability	Criteria	Person Reliability	Criteria	Conclusion
0.67	Enough	0.95	Special	0.64	Enough	Reliable

Based on Table 4, it is known that the ALSKII instrument is declared reliable for measuring contextual scientific literacy skills integrated with religion and state for prospective students of science education teachers. This is evidenced by the Cronbach alpha value of 0.67 with sufficient criteria, the item reliability value of 0.95 with special criteria, and the person reliability value of 0.64 with sufficient criteria.

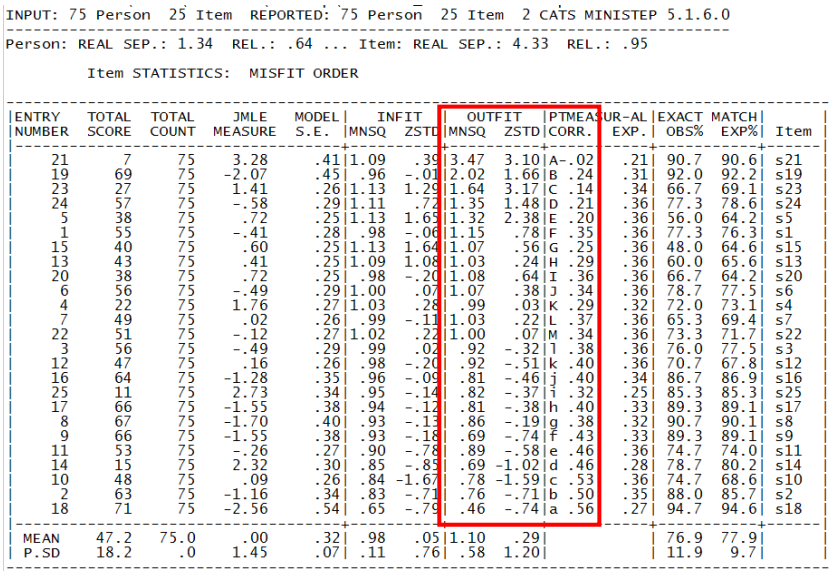
The results of the ALSKII trial data analysis using the Ministep evaluation/student version of Winsteps 5.1.6.0 application in the form of standardized residual variance (23.0) output are shown in Figure 2 and Figure 3 in the form of item fit orders.



```
INPUT: 75 Person  25 Item  REPORTED: 75 Person  25 Item  2 CATS MINISTEP 5.1.6.0
-------------------------------------------------------------------------------

     Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units
                                          Eigenvalue   Observed   Expected
Total raw variance in observations     =     38.4882 100.0%          100.0%
  Raw variance explained by measures   =     13.4882  35.0%           34.8%
    Raw variance explained by persons  =      4.0130  10.4%           10.3%
    Raw Variance explained by items    =      9.4753  24.6%           24.4%
  Raw unexplained variance (total)     =     25.0000  65.0% 100.0%    65.2%
    Unexplned variance in 1st contrast =      2.2727   5.9%   9.1%
    Unexplned variance in 2nd contrast =      2.1086   5.5%   8.4%
    Unexplned variance in 3rd contrast =      1.9041   4.9%   7.6%
    Unexplned variance in 4th contrast =      1.7653   4.6%   7.1%
    Unexplned variance in 5th contrast =      1.6789   4.4%   6.7%
```

Figure 2. Standardized Residual Variance



```
INPUT: 75 Person  25 Item  REPORTED: 75 Person  25 Item  2 CATS MINISTEP 5.1.6.0
-------------------------------------------------------------------------------
Person: REAL SEP.: 1.34  REL.: .64 ... Item: REAL SEP.: 4.33  REL.: .95

         Item STATISTICS:  MISFIT ORDER

-------------------------------------------------------------------------------
|ENTRY   TOTAL  TOTAL    JMLE   MODEL|   INFIT   |   OUTFIT   |PTMEASUR-AL|EXACT MATCH|      |
|NUMBER  SCORE  COUNT  MEASURE  S.E. |MNSQ  ZSTD|MNSQ  ZSTD|CORR.  EXP.|OBS%  EXP%| Item |
|------------------------------------+----------+----------+-----------+----------+------|
|    21      7     75     3.28    .41|1.09   .3|3.47  3.10|A-.02   .21| 90.7  90.6| s21  |
|    19     69     75    -2.07    .45| .96  -.0|2.02  1.66|B .24   .31| 92.0  92.2| s19  |
|    23     27     75     1.41    .26|1.13  1.2|1.64  3.17|C .14   .34| 66.7  69.1| s23  |
|    24     57     75     -.58    .29|1.11   .7|1.35  1.48|D .21   .36| 77.3  78.6| s24  |
|     5     38     75      .72    .25|1.13  1.6|1.32  2.38|E .20   .36| 56.0  64.2| s5   |
|     1     55     75     -.41    .28| .98  -.0|1.15   .78|F .35   .36| 77.3  76.3| s1   |
|    15     40     75      .60    .25|1.13  1.6|1.07   .56|G .25   .36| 48.0  64.6| s15  |
|    13     43     75      .41    .25|1.09  1.0|1.03   .24|H .29   .36| 60.0  65.6| s13  |
|    20     38     75      .72    .25| .98  -.2|1.08   .64|I .36   .36| 66.7  64.2| s20  |
|     6     56     75     -.49    .29|1.00   .0|1.07   .38|J .34   .36| 78.7  77.5| s6   |
|     4     22     75     1.76    .27|1.03   .2| .99   .03|K .29   .32| 72.0  73.1| s4   |
|     7     49     75      .02    .26| .99  -.1|1.03   .22|L .37   .36| 65.3  69.4| s7   |
|    22     51     75     -.12    .27|1.02   .2|1.00   .07|M .34   .36| 73.3  71.7| s22  |
|     3     56     75     -.49    .29| .99   .0| .92  -.32|l .38   .36| 76.0  77.5| s3   |
|    12     47     75      .16    .26| .98  -.2| .92  -.51|k .40   .36| 70.7  67.8| s12  |
|    16     64     75    -1.28    .35| .96  -.0| .81  -.46|j .40   .34| 86.7  86.9| s16  |
|    25     11     75     2.73    .34| .95  -.1| .82  -.37|i .32   .25| 85.3  85.3| s25  |
|    17     66     75    -1.55    .38| .94  -.1| .81  -.38|h .40   .33| 89.3  89.1| s17  |
|     8     67     75    -1.70    .40| .93  -.1| .86  -.19|g .38   .32| 90.7  90.1| s8   |
|     9     66     75    -1.55    .38| .93  -.1| .69  -.74|f .43   .33| 89.3  89.1| s9   |
|    11     53     75     -.26    .27| .90  -.7| .89  -.58|e .46   .36| 74.7  74.0| s11  |
|    14     15     75     2.32    .30| .85  -.8| .69 -1.02|d .46   .28| 78.7  80.2| s14  |
|    10     48     75      .09    .26| .84 -1.6| .78 -1.59|c .53   .36| 74.7  68.6| s10  |
|     2     63     75    -1.16    .34| .83  -.7| .76  -.71|b .50   .35| 88.0  85.7| s2   |
|    18     71     75    -2.56    .54| .65  -.7| .46  -.74|a .56   .27| 94.7  94.6| s18  |
|------------------------------------+----------+----------+-----------+----------+------|
| MEAN    47.2   75.0     .00    .32| .98   .0|1.10   .29|           | 76.9  77.9|      |
| P.SD    18.2    .0    1.45    .07| .11   .7| .58  1.20|           | 11.9   9.7|      |
-------------------------------------------------------------------------------
```

Figure 3. Output Item Fit Order

Instrument validity is the ability of a measuring instrument to measure what will actually be measured(Baghaei & Aryadoust, 2015; Sumintono & Widhiarso, 2013). In Figure 2, the value

of raw variance explained by measures shows a figure of 35%. This percentage In Figure 2, the value of raw variance explained by measures shows the figure of 35%. This percentage indicates that the validity of the ALSKII instrument is fulfilled(Baghaei & Aryadoust, 2015; Sumintono & Widhiarso, 2013). In addition, Figure 2 shows the eigenvalue in the unexplained variance $1st$ contrast of 2.27 (less than 3) indicating that there are no problematic items.(Sumintono & Widhiarso, 2013). Figure 2 also shows the observed value of 5.9% (less than 15%) indicating that the items are fit (item fit). The unexplained variance value in the first construct residual PCA of 5.9% indicates strong validity because it is in the range of 5-10%(Baghaei & Aryadoust, 2015). Item fit shows that the items are able to measure what they want to measure. The results of processing the validity of the ALSKII instrument using the Rasch model are shown in Table 5.

Table 5. The results of processing the validity of the ALSKII instrument

Raw variance explained by measures	Criteria	Unexplained variance 1st contrast		Conclusion
		Eigenvalue	Observed	
35.0%	fulfilled	2.27	5.9%	There are no problematic items

Based on Table 5 shows that the instrument is declared valid and there are no problematic items. Furthermore, an analysis of the validity of the items is carried out (item validity).

The analysis of item validity is carried out based on the results of the item fit order output in Figure 3 and the item fit criteria based on Table 3. If all three criteria are met on the item, it can be said that the item is "appropriate" and it can be ascertained that the quality of the item is good and can be used. If there are only two criteria or one criterion that is met, then the items can still be maintained and do not need to be changed so that they can be categorized as "appropriate" and can be used. If the three criteria are not met, it can be stated that the item is not suitable so it needs to be repaired or replaced. The results of processing the suitability of items can be seen in Table 6.

Table 6. The results of the item fit analysis of the ALSKII instrument

Question number	Question code	Outfit		Pt Measure Corr.	Misfit	Conclusion
		MNSQ	ZFTD			
21	S21	3.47	3.10	-0.02	3 Criteria	It is not in accordance with
19	S19	2.02	1.66	0.24	2 Criteria	In accordance
23	S23	1.64	3.17	0.14	3 Criteria	It is not in accordance with
24	S24	1.35	1.48	0.21	1 Criteria	In accordance
5	S5	1.32	2.38	0.20	2 Criteria	In accordance
1	S1	1.15	0.78	0.35	1 Criteria	In accordance
15	S15	1.07	0.56	0.25	1 Criteria	In accordance
13	S13	1.03	0.24	0.29	1 Criteria	In accordance
20	S20	1.08	0.64	0.36	1 Criteria	In accordance
6	S6	1.07	0.38	0.34	1 Criteria	In accordance
4	S4	0.99	0.03	0.29	1 Criteria	In accordance
7	S7	1.03	0.22	0.37	1 Criteria	In accordance
22	S22	1.00	0.07	0.34	1 Criteria	In accordance
3	S3	0.92	-0.32	0.38	1 Criteria	In accordance
12	S12	0.92	-0.51	0.40	-	In accordance
16	S16	0.81	-0.46	0.40	-	In accordance
25	S25	0.82	-0.37	0.32	-	In accordance
17	S17	0.81	-0.38	0.40	-	In accordance
8	S8	0.86	-0.19	0.38	-	In accordance

9	S9	0.69	-0.74	0.43	-	In accordance
11	S11	0.89	-0.58	0.46	-	In accordance
14	S14	0.69	-1.02	0.46	-	In accordance
10	S10	0.78	-1.59	0.53	-	In accordance
2	S2	0.76	-0.71	0.50	-	In accordance
18	S18	0.46	-0.74	0.56	-	In accordance

Based on Table 6, it is known that two items are not suitable, namely numbers 21st and 23rd because they do not meet the three criteria for item fit so they must be revised or replaced. Meanwhile, the other 23 items were declared fit or valid so that they could be used immediately without revision. Overall, the results of the item fit analysis showed 23 of the 25 items were declared valid.

CONCLUSION

The validity and reliability of the instrument using the Rasch Model produces more holistic quality information based on the testee and the item at the same time. Based on the test results using the Rasch Model, it can be concluded that the scientific literacy assessment instrument integrated with religion and state is valid and reliable. This instrument can be an alternative in the assessment of scientific literacy based on religion and the state. The instrument can also be further developed according to the context and socio-scientific issues that need to be solved in the community.

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