



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 9, Issue 11, November 2020

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.512**

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

# Quality Analysis on the Survey Instruments of Self-Assessment of Nuclear Security Culture Using Classical Test Theory and Rasch Model

Muhamad Setyawan Bahari<sup>1</sup>, Jumadiono Jumadiono<sup>1</sup>

Division of Nuclear Security, Bureau for Legal, Public Relations, and Cooperation, National Nuclear Energy Agency of Indonesia (BATAN), Jakarta, Indonesia<sup>1</sup>

**ABSTRACT:** This study intends to analyze the quality of the survey instrument of self-assessment of nuclear security culture using the classical test theory approach and Rasch model in terms of validity and reliability. Researchers developed the survey instrument based on IAEA Nuclear Security Series No. 28-T entitled Self-Assessment of Nuclear Security Culture in Facility and Activities. Thirty respondents filled out questionnaires containing 25 items related to nuclear security culture. The data obtained were analyzed using a classical test theory and Rasch model. In terms of validity, the classical test theory approach shows that all 25 items are valid. In contrast, with the Rasch model, 17 items are valid, and eight are invalid. The reliability value of Cronbach Alpha (KR-20) through the classical test theory approach is 0.952 (Very High), and the Cronbach Alpha (KR-20) reliability value in the Rasch model is 0.56 (Moderate). In the Rasch model, it also has Person Reliability and Item Reliability value of 0.49 (Poor) and 0.96 (Excellent), respectively.

**KEYWORDS:** Nuclear Security Culture, Classical Test Theory, Rasch Model

## I. INTRODUCTION

To ensure that all facilities are secure and as a form of commitment to prioritizing nuclear security, the National Nuclear Energy Agency (BATAN) has established a Nuclear Security Policy. The BATAN Nuclear Security Policy states that:

*"... Every employee of the National Nuclear Energy Agency is obliged to pursue nuclear security objectives, implement and develop a nuclear security culture by their respective responsibilities and roles."*

Nuclear security culture is the assembly of characteristics, attitudes, and behavior of individuals, organizations, and institutions that serve to support and enhance nuclear security [1]. Nuclear security culture includes beliefs and attitudes, principles, management systems, and behaviour. The harmony of all of them will contribute to more effective nuclear security.

BATAN has conducted a self-assessment of nuclear security culture. The purpose of the self-assessment of security culture is to provide a clear picture of the extent to which nuclear security is part of an organization's culture [2]. The self-assessment of nuclear security culture is carried out based on the Nuclear Security Series No. 28-T entitled Self-assessment of Nuclear Security Culture in Facilities and Activities. This assessment consists of four stages consisting of a survey, interview, document review, and observation. The survey is the main instrument used in the self-assessment process to obtain the baseline data. So far, the study's tool is a questionnaire containing statement items regarding the characteristics and indicators of nuclear security culture.

The test instrument is declared good quality if it has high validity and reliability. The higher the validity and reliability of an instrument, the more accurate the research will be [3]. The instrument's validity is how far the instrument's measurement can measure what attributes should be measured. It means that the tools used to measure the objectives that have been set. In addition to validity, a statement item given to the respondent must also be reliable (steady). Reliability describes how far multiple measurements will yield the same information. It means that there are not many significant differences [4].

Instrument analysis can be carried out using 2 (two) approaches. The first approach is the classical test theory (CTT), and the modern approach using Rasch modelling (Rasch model). CTT was initiated by Charles Spearman in 1904 and is a popular psychometric theory and is widely used for various disciplines (psychology, education, and other social sciences) [4]. CTT has a weakness because it is an examinee sample dependent and item sample dependent [5] [6] [7] [8] [9].



The shortcomings of CTT were then corrected using item response theory (IRT) with various parameter logic (PL), 1PL, developed into a Rasch model. Unlike CTT, which always depends on scores, IRT does not depend on a specific sample of questions/statements and the ability of people involved in the exam/survey [10]. The Rasch Model is a psychometric technique developed to improve a constructed instrument's precision, monitor an instrument's quality, and compute respondents' performances [11].

This study analyzes the instrument's quality in terms of validity and reliability using classical test theory and the Rasch model. The measurement instrument analyzed in this study was the survey questionnaire statement items. This analysis was conducted to improve the quality of the survey instrument of self-assessment of nuclear security culture.

## II. METHODOLOGY

This research uses data from the survey instruments of self-assessment of nuclear security culture in 2020. The survey instrument is in the form of 25 statement items with a scale of 1 - 7. The statements are taken from the characteristics and indicators of nuclear security culture in Nuclear Security Series No. 28-T. The questionnaire was tested on 30 BATAN employees from various work units and was given via Google Form. This study intends to find information and data that can be used to describe survey instruments in terms of validity and reliability. Validity and reliability were tested using the classical test theory approach and the Rasch model.

## III. EXPERIMENTAL RESULTS

### A. Validity

The validity test of the classical test theory uses the Pearson correlation analysis method by correlating the item scores with each variable's total item scores. If  $r_{count} > r_{table}$ , the item can be declared valid. If  $r_{count} < r_{table}$ , the item is displayed invalid [12].

In the Rasch model, the validity aspect is seen from the value of outfit means-square, outfit z-standard, and point measure correlation. The value of outfit means-square, outfit z-standard, and point measure correlation are the criteria used to see the item's suitability. If the items on the three criteria are not fulfilled, it can be ascertained that the question item is not good enough that it needs to be repaired or replaced [13] [14]. According to Boone et al. [13], the criteria used to check the suitability of items that are not suitable (outliers or misfits) are

Tabel 1. Fit Indices for Item Fit

Statistics	Fit Indices
Outfit mean square (MNSQ)	0.5 - 1.5
Outfit Z-standard (ZSTD)	-2.0 - 2.0
Point Measure Correlation (Pt Measure Corr)	0.4 - 0.85

A comparison of the item validity analysis results was obtained between the classical test theory and the Rasch model. The comparison of the analysis can be seen in Table 2.

Table 2. Comparison of the results of the validity test

No	Result	Statement Number	
		Classical Test Theory	Rasch model
1.	Valid	1 – 25	1, 2, 3, 4, 5, 7, 10, 12, 13, 15, 16, 18, 20, 21, 22, 23, 25
2.	Invalid	-	6, 8, 9, 11, 14, 17, 19, 24

The validity test of the classical test theory obtained information that all 25 statements were declared valid, or there were no invalid statements. In comparison, the Rasch model's validity test found that only 17 items were declared valid, and 8 were invalid. Based on the validity test results using the classical test theory and the Rasch model, differences were found. The number of valid statement items in the classical test theory is more than the Rasch model. An item is categorized as valid in the Rasch model if it meets the Outfit MNSQ, Outfit ZSTD, and PT Measure Corr criteria.

These results prove that items that are declared valid in classical test theory will not necessarily be in the same category in the Rasch model. Researchers can replace or repair invalid statement items so that they can be used as instruments.

### B. Reliability

The reliability aspect of the classical test theory can be tested using Cronbach's Alpha method. As stated by Guilford [15], the reliability value criteria can be seen in Table 3.

Table 3. Guilford's Reliability Criteria

Amount of $r_{11}$	Interpretation
$r_{11} \leq 0,20$	Very low
$0,20 < r_{11} \leq 0,40$	Low
$0,40 < r_{11} \leq 0,60$	Intermediate
$0,60 < r_{11} \leq 0,80$	High
$0,80 < r_{11} \leq 1,00$	Very high

In the Rasch model, the criteria for determining the value of Cronbach's alpha, person reliability, and item reliability can be seen in Table 4 [15].

Table 4. Reliability Criteria for the Rasch Model

Statistics	Fit Indices	Interpretation
Cronbach's alpha (KR-20)	< 0,5	Low
	0,5-0,6	Moderate
	0,6 -0,7	Good
	0,7-0,8	High
	> 0,8	Very High
Item and Person Reliability	< 0,67	Poor
	0,67 – 0,80	Fair
	0,80 – 0,90	Good
	0,91 – 0,94	Very good
	> 0,94	Excellent

There were differences in reliability test results between the classical test theory and the Rasch model. The results of the reliability test both can be seen in Table 5.

Table 5. Comparison of Reliability Test Results

Approach	Statistics	Fit Indices	Interpretation
Classical Test Theory	Cronbach's Alpha (KR-20)	0.952	Very High
Rasch Model	Cronbach's Alpha (KR-20)	0.56	Moderate
	Person Reliability	0.49	Poor
	Item Reliability	0.96	Excellent

The reliability test used the classical test theory in terms of the Cronbach's Alpha (KR-20) value. KR-20 value shows the interaction between person and item as a whole. The reliability value obtained was 0.952 and categorized as Very High. In the Rasch model, the Cronbach Alpha value is 0.56 (Moderate). Based on the results above, it is also known that there is a difference in the Person Reliability value, namely 0.49 (Poor), and the Item Reliability value, namely 0.96 (Excellent). This significant difference in results indicates that the respondents' consistency in answering the questionnaire is very weak or inconsistent. However, based on the Item Reliability value obtained, it can be concluded that the quality of the statement items in the instrument has a good reliability aspect.

## IV. CONCLUSION

In terms of validity and reliability aspects, there are differences in the results of the two approaches. In the classical test theory, all items were declared valid, while only 17 were valid in the Rasch model approach. The reliability value of Cronbach's Alpha (KR-20) using the classical test theory approach is 0.952 (Very High) and 0.56 (Moderate) in the Rasch model. It also has known Person Reliability and Item Reliability value of 0.49 (Poor) and 0.96 (Excellent), respectively.



#### REFERENCES

- [1] IAEA. (2008). IAEA Nuclear Security Series No. 7: Nuclear Security Culture. Vienna: International Atomic Energy Agency. p. 3.
- [2] IAEA. (2017). IAEA Nuclear Security Series No. 28-T: Self-assessment of Nuclear Security Culture in Facilities and Activities. Vienna: International Atomic Energy Agency. p. 7.
- [3] Hayati, S., & Lailatussaadah, L. (2016). Validitas dan Reliabilitas Instrumen Pengetahuan Pembelajaran Aktif, Kreatif dan Menyenangkan (Pakem) Menggunakan Model Rasch. *Jurnal Ilmiah Didaktika*, 16(2), p. 169–179.
- [4] Sumintono, B., & Widhiarso, W. (2013). *Aplikasi Pemodelan Rasch untuk Penelitian Ilmu-Ilmu Sosial*. Cimahi: Trim Komunikata Publishing House.
- [5] Lord, F. M. (1980). *Application of Item Response Theory to Practical Testing Problems*. Hillsdale, New Jersey: Lawrence Erlbaum Associates Publishers.
- [6] Hambleton, R. K., & Swaminathan, H. (1985). *Item Response Theory: Principles and Application*. Boston, MA: Kluwer, Inc.
- [7] Hambleton, R. K., Swaminathan, H., & Rogers, H. J. (1991). *Fundamentals of Item Response Theory*. CA: Sage Publication Inc.
- [8] Fan, X. (1998). Item Response Theory and Classical Test Theory: An Empirical Comparison of Their Item/Response Person Statistics. *Educational and Psychological Measurement*, 58 (3), 357-381.
- [9] Hambleton, R. K., Robin, F., & Xing, D. (2000). Item Response Models for the Analysis of Educational and Psychological Test Data. Dalam H. E. Tinsley, & S. D. Brown, *Handbook of applied multivariate statistics and mathematical modelling* (p. 553-581). San Diego, CA: Academic Press.
- [10] Sumintono, B. (2014). Model Rasch untuk Penelitian Sosial Kuantitatif. Makalah Kuliah Umum Di Jurusan Statistika, ITS Surabaya, 21 November 2014, November 201, 1–9. [https://www.researchgate.net/publication/268688670\\_Model\\_Rasch\\_untuk\\_Penelitian\\_Sosial\\_Kuantitatif](https://www.researchgate.net/publication/268688670_Model_Rasch_untuk_Penelitian_Sosial_Kuantitatif)
- [11] Boone, W. J. (2016). Rasch Analysis for Instrument Development: Why, When, and How? *CBE Life Sciences Education*, 15(4), rm4. <https://doi.org/10.1187/cbe.16-04-0148>
- [12] Priyatno, D. (2018). *SPSS Panduan Olah Data Bagi Mahasiswa & Umum*. Yogyakarta: Penerbit ANDI.
- [13] Boone, W. J., Staver, R. J., & Yale, S. M. (2014). *Rasch Analysis in the Human Sciences*. London: Springer.
- [14] Bond, T.G. and Fox, C.M. (2015). *Applying the Rasch Model, Fundamental Measurement in the Human Sciences* (3rd edition). New York: Routledge.
- [15] Guilford, J. (1956). *Fundamental statistics in psychology and education*. New York: McGraw Hill.
- [16] Sumintono, B., & Widhiarso, W. (2015). *Aplikasi Pemodelan Rasch Pada Assessment Pendidikan*. Cimahi: Trim Komunikata Publishing House.



**INNO**  **SPACE**  
SJIF Scientific Journal Impact Factor

**Impact Factor:  
7.512**

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
**INDIA**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details