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Rasch Model Application to Examine the Psychometric Properties of Premarital Sexual Behaviour Scalogram

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ABSTRACT

The facts of pre-marital sexual behaviour (PSB) in adolescent are worrying, then if this condition continued so Indonesia would have low quality generation both physically and psychologically. This research addressed to validate pre-marital sexual behaviour scalogram. Validation process is essential because the useful measurement tool will be able to reveal pre-marital sexual behaviour in order to acquire a precise and accurate description of adolescents pre-marital sexual behaviour. Four hundred junior high school students participated in this study. Rasch analysis was applied to validate the scalogram that consisted of 10 items ranging from the most until the least PSB committed by participants, using the R program *latent trait model* package. The results showed that this scalogram is sensitive to describe PSB in both low level ($\theta \leq 0$) and high level ($\theta \geq 2{,}5$).

1. Introduction

One of the important thing in social and psychological quantitative research is the instrument for data collection so that the data obtained could provide accurate and objective information (Azwar, 2011). There are must criteria to be met by every psychological measurement tool to be a useful measurement tool, which is reliable, valid, standard, economical and practical. Reliable and valid instruments will provide *reliable* information. Contrarily, instruments that fail to meet the requirements will produce bias or misleading results that may decrease the quality of the research (Sumintono & Widhiharso, 2015).

This study will examine the psychometric properties of pre-marital sexual behaviour measurement instruments in adolescents. There have been many studies conducted on pre-marital sexual behaviour in adolescents, but there has been no report on the psychometric properties of the measurement instrument. Therefore, this becomes important because the excellent measurement tool will be able to reveal pre-marital sexual behaviour in order to obtain a precise and accurate description of sexual behaviour. An unreliable or invalid measure instrument will provide inaccurate information about pre-marital sexual behaviour perpetrated by adolescents. If the misinformation then used as the basis for making a conclusion and decision, then they will be the misleading conclusions and decisions (Azwar, 2011)

Furthermore, Azwar (2011) suggests that the main idea of the concept of reliability is how far the results of a measurement can be reliant. According to Sumintono & Widhiharso (2015), reliability explains how far a given measurement tool or a test produced the same information when they administered several times, or there is no significant difference in information produced. One of the bases to conclude that the information resulted in the same or steady is internal consistency. Internal consistency emphasizes consistency in the items of the instrument. Instruments aimed at revealing *latent traits* typically contain a form of a statement that must be responded by the participants. Internal consistency explains how the various items induce information that is consistent with each other and differs in the same direction. However, the reliability value depends on the characteristics of the sample. Several approaches have been introduced to estimate the relative reliability of sample characteristics, one of which is reliability based on modern theory is Item Response Theory or Rasch.

Pre-marital sexual behaviour examined in this study is a scalogram comprising items about the level of sexual activity starting from holding hands, hugging, kissing cheek, kissing lips, touching breast/genitals (dressed/undressed), petting (dressed/undressed), and sexual intercourse.

1.1 Rasch Model

Rasch model emerged from the analysis performed by Dr Georg Rasch, a mathematician from Denmark, who has proposed a famous statement, that "the opportunity to solve a problem depends on the ratio between the abilities of the person and the degree of difficulty of the matter".

For dichotomous data, Rasch modelling combines an algorithm that expresses the probabilistic expectation results of the "i" and the respondents "n", which is mathematically expressed as follows (Bond and Fox (2007) in Sumintono & Widhiharso, 2015):

$$P_{ni}(X_{ni} = 1 \,/\, \beta_n, \delta_i)) = \frac{e^{(\beta n - \delta_i)}}{1+e^{(\beta n - \delta_i)}} \quad \ldots\ldots\ldots\ldots (1)$$

Note: $P(X_{ni} = 1/\beta_n , \delta_i)$ is the probability of respondent n in item i to produce the correct answer (x = 1); with the ability of respondents, βn, and difficulty level item δi.

The equation can be further simplified by entering the logarithm function and making it

$$\text{Log } (P(X_{ni} = 1 \,/\, \beta_n, \delta_i)) = \beta_n - \delta_i$$

Thus, the probability of a success can be written as:

Probability to succeed	=	Ability of respondent	-	Item difficulty level

A particular item could have said been fulfilling its measuring function when able to distinguish between the respondents who are able and who are not. Two things need to be discussed further about Rasch modelling. Firstly, the misfit probability of the respondents involved in the given test (or the participants in the questionnaire survey). Rasch modelling able to detect the presence of respondents who are not appropriate to be involved based on the response provided. Providing information about whether a specific respondent needs to be excluded or keep included is an advantage of the Rasch model. The finding will contribute significantly to the undertaken research.

Secondly, it is related to the items. If the response was discovered to indicate that there are items that cannot distinguish the respondent's ability - between able and not able - then the item needs to be revised or dropped. In a particular, extreme condition when the results obtained are too misfit, or most items have poor performance, then we need to fix all the items or fix all the statements because they do not measure what should be measured (doubtful validity). Therefore, improvements need to be performing, such as preparing new items and then re-test them. This eminence clearly shows that the Rasch model is not just estimating item reliability, but also testing the validity of the instruments used.

The Rasch analysis technique in its development has been conducted in various fields of psychology, such as the measurement of interest (Lamb et al., 2012; Primé & Tracey, 2010; Vock et al., 2013), ability (Pomeranz et al., 2008), behaviour (Winterstein et al., 2011; Wyse & Mapuranga, 2009), and education (Byrne et al., 2008; Carlson & Davier, 2013; Muis et al., 2009).

1.2 Scalogram (Guttman Matrix)

Guttman gives an idea about one of the measurement techniques in quantitative research, which then called scalogram. Guttman introduces an attitude ranking scale from the lowest to the highest, developed into a specific matrix, based on certain criteria, for example, based on the intensity or relevance. Scalogram addresses to facilitate us to analyze, provide explanations and to predict the ability of individuals as well as the difficulty level of problems or items.

The scalogram, for example, can be used to measure pre-marital sexual behaviours that ordered based on their intensity start from starring, holding hands, kissing, until sexual intercourse. If an Adolescent reported kissing once, meaning that he should also report that he once held hands. The explanation of Guttman's matrix shows that the principle of sorting based on abilities and the degree of

difficulty of the question is useful for explaining abilities, even predicting one's ability. The Guttman matrix is the basis of the Rasch model (Sumintono & Widhiharso, 2015)

2. Methods

Pre-marital Sexual Behaviour scalogram is a questionnaire with a dichotomous response that contains the sexual behaviour of the subject. The items indicate the level of sexual activity starting from holding hands, hugging, kissing cheek, kissing lips, touching breast/genitals (dressed/undressed), petting (dressed/undressed), and sexual intercourse based on the theory of Sarwono (2006). The yes answer scored 1, and 0 is for no answer.

The study subjected four hundred junior high school students in the suburban area in Special Regency of Yogyakarta. The reason for taking the subject based on the fact that perpetrators of pre-marital sexual behaviour today have an increasingly young age. The research data collected through the scalogram will be validated by the Rasch method using R program *latent trait model* package. The scalogram administered in Bahasa Indonesia, as displayed in the table 1.

Table 1.
Pre-marital Sexual Behaviour Scalogram

Pre-marital Sexual Behaviour	Yes	No
Berpegangan tangan (P1)		
Berpelukan/dipeluk/memeluk (P2)		
Dicium/mencium kening (P3)		
Dicium/mencium pipi (P4)		
Dicium/mencium bibir (P5)		
Meraba/diraba pada payudara/alat kelamin (masih berpakaian) (P6)		
Saling menempelkan alat kelamin (masih berpakaian) (P7)		
Saling meraba tubuh, seperti payudara/alat kelamin (di dalam pakaian/tanpa pakaian) (P8)		
Saling menempelkan alat kelamin (P9)		
Melakukan hubungan seksual (P10)		

3. Findings and Discussion

This research are willing to present the participant characteristic descriptively. The subject of pre-marital sexual behaviour described as follows (see Table 2).

Table 2.
The pre-marital sexual behaviour data description (N=400)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Mean	0.86	0.53	0.51	0.46	0.32	0.1	0.03	0.03	0.02	0.02
SD	0.347	0.5	0.5	0.499	0.465	0.30	0.164	0.164	0.122	0.122
Minimum	0	0	0	0	0	0	0	0	0	0
Maximum	1	1	1	1	1	1	1	1	1	1

From table 1, the highest average value is at item P1 that is equal to 0.86, whereas item P9 and P10 are the items with the lowest average is 0.02. It shows that almost all the subject held hands (P1), and only a small amount of subjects had sexual intercourse (P10).

3.1 Item Discrimination and Scale Reliability with Classical Test Theory (CTT)

The discrimination index and scale reliability of pre-marital sexual behaviour scalogram were examined by both CTT and Rasch approach. The CTT correlate a given item score to item-total score with the R program *latent trait model* package. The higher the correlation coefficient, the higher discrimination. Alpha Cronbach formula was applied to obtain reliability. A measurement tool of research would be considered reliable if the α value more than 0.60 (Azwar, 2011)

Table 3.
Item discrimination with CTT

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
P1	.389	.820
P2	.714	.784
P3	.756	.777
P4	.737	.780
P5	.721	.782
P6	.478	.812
P7	.343	.824
P8	.372	.823
P9	.334	.826
P10	.334	.826

Table 3 illustrates that all the items have the corrected item-total correlation score higher than 0,300, which are ranging from 0,343 to 0,756, so it could be concluded that all the items of the pre-marital sexual behaviour scalogram have excellent discrimination. Cronbach's alpha of 0,824 (refer to table 4) indicates that the scalogram has high reliability. If item P9 and P10 deleted, as shown in Table 3, the Cronbach's Alpha would increase to 0,826. Those two items keep included in the scalogram, considering only 0,002 points of increment.

Table 4.
Scale Reliability Statistics

	Cronbach's α
Scale	0.824

3.2 Rasch Model

The R program performed the Rasch analysis in this research. The output of LTM (*latent trait model*) package as in table 5 proved in the Rasch model the item's difficulty level ranging from -1,19 (P1) to 2,37 (P9 dan P10). The lowest difficulty level means it is the most pre-marital sexual behaviour undertook by the adolescent. The highest difficulty level means only a few adolescents commit pre-marital sexual behaviour. Rasch model assumes that all the items have the same discrimination, which is 5,56.

Table 5.
Item's difficulty level in the Rasch Model

	Difficulty level	Discrimination
P1	-1.18811075	5.563833
P2	-0.10414276	5.563833
P3	-0.06008011	5.563833
P4	0.06309206	5.563833
P5	0.49710887	5.563833
P6	1.35348961	5.563833
P7	2.04139204	5.563833
P8	2.04144387	5.563833
P9	2.37426918	5.563833
P10	2.37426918	5.563833

Item characteristic curves of the difficulty level of each item presented in the picture below (see Figure 1).

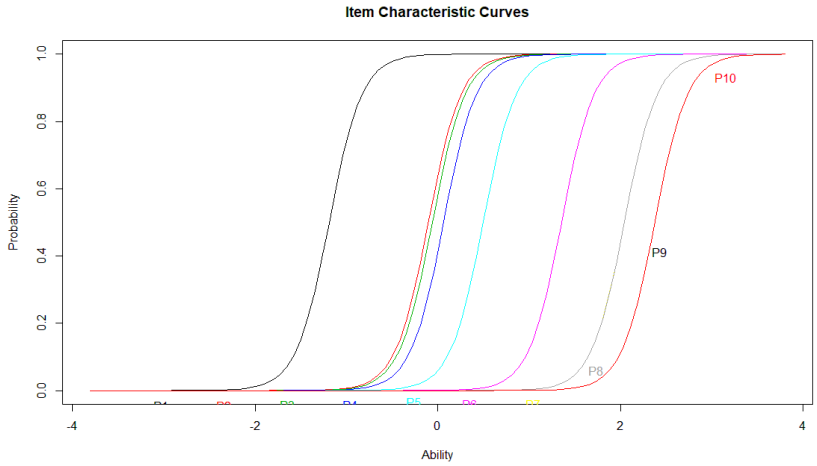

Figure 1. Item characteristic curves of pre-marital sexual behaviour in adolescents

From table 5 and figure 1, item P1 – P5 were "easy" items for the subject. It means that most of them have held hands, hugged, kissed on the cheek, kissed on the forehead, and kissed on lips. Adolescents with low pre-marital sexual behaviour (ability (θ)< 0) more likely to do this behaviour with their girlfriend/boyfriend, rather than item P7 – P10, namely touching breast/genital (undressed), petting (dressed), petting (undressed), and sexual intercourse, which were more likely to be done by adolescents with high pre-marital sexual behaviour (ability (θ)> 0,5). Item P6 represents touching breast or genital (dressed), was most likely to be done by moderate pre-marital sexual behaviour. Item P9 and P10 rarely committed by adolescents, except those with very high pre-marital sexual behaviour (θ ≥2). The results confirmed the items of pre-marital sexual behaviour scalogram are on the right order, from the lowest or most likely to the highest or least likely to be performed by adolescents.
This study also examines the fitness of the items in this scalogram to the model of pre-marital sexual behaviour. The results of *Item-Fit statistics* as in table 6 below:

Table 6.
Item-Fit Statistics in Rasch

Item	χ^2	p
P1	476.0620	<0.0001
P2	19.3080	0.0133
P3	28.6261	0.0004
P4	11.8825	0.1565
P5	19.2213	0.0137
P6	177.8807	<0.0001
P7	5.2629	0.7291
P8	5.5755	0.6947
P9	0.7312	0.9994
P10	0.7312	0.9994

Rasch model analysis results fit statistics that give information to researcher whether the obtained data ideally describe that the high ability subjects (e.i subjects with the high pre-marital sexual behaviour) respond the items according to its difficulty level. Table 6 informed that item P1, P3, dan P6 (p<0,01) less ideal in depicted subject's pre-marital sexual behaviour. Subjects that reported hugged, ideally, they have held hands, but the obtained data in this model did not perform that results. Item P6 containing the problem of which subjects did not report that they were touching to each other in dress, yet they have done it undress.

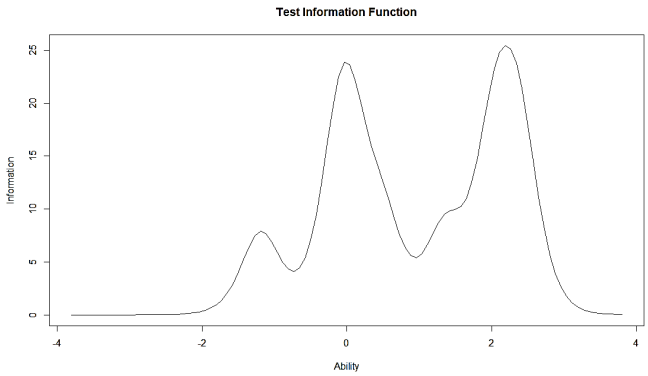

Figure 2. Test Information Function of pre-marital sexual behaviour scalogram

Test Information Function (TIF) plot provide information about how proper given assessment tools estimate a person's ability (θ). In this study, the TIF advise about adolescent's pre-marital sexual behaviour. Picture 2 showed that this scalogram able to give maximum information for subjects with low (θ =0) and high (θ =2,5) ability, or subjects with low and high pre-marital sexual behaviour. Furthermore, to detect the fitness of a person's score-item pattern in the Rasch Model or another model in a sample, person-fit measurement analysis was applied (Meijer & Sijtsma, 2001). The results of person – fit statistics tests as in the table below:

Tabel 7.
Person- fit Statistics dalam Rasch Model

No	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	L0	Lz	Pr(<Lz)
1	0	0	0	0	0	0	0	0	0	0	-0.286	0.504	0.693
2	0	0	0	1	0	0	0	0	0	0	-7.141	-5.028	<0.0001
3	1	0	0	0	0	0	0	0	0	0	-0.180	0.423	0.664
4	1	0	0	0	1	0	0	0	0	0	-4.942	-3.241	0.001
5	1	0	0	1	0	0	0	0	0	0	-2.527	-0.574	0.283
6	1	0	0	1	1	0	0	0	0	0	-2.502	-0.534	0.297
7	1	0	1	0	0	0	0	0	0	0	-1.842	0.183	0.573
8	1	0	1	1	0	0	0	0	0	0	-2.451	-0.255	0.400
9	1	0	1	1	1	0	0	0	0	0	-4.076	-1.928	0.027
10	1	1	0	0	0	0	0	0	0	0	-1.597	0.454	0.675
11	1	1	0	1	0	0	0	0	0	0	-2.206	0.015	0.506
12	1	1	0	1	1	0	0	0	0	0	-3.831	-1.730	0.042
13	1	1	1	0	0	0	0	0	0	0	-1.520	0.768	0.779
14	1	1	1	0	1	0	0	0	0	0	-3.146	-1.174	0.120
15	1	1	1	1	0	0	0	0	0	0	-0.731	0.784	0.783
16	1	1	1	1	0	1	0	0	0	0	-5.015	-3.420	0.000
17	1	1	1	1	1	0	0	0	0	0	-0.250	0.451	0.674
18	1	1	1	1	1	0	0	1	1	1	-8.964	-6.643	<0.0001
19	1	1	1	1	1	0	1	0	0	0	-4.354	-2.796	0.003
20	1	1	1	1	1	1	0	0	0	0	-0.527	0.482	0.685
21	1	1	1	1	1	1	0	1	0	0	-1.750	0.099	0.539
22	1	1	1	1	1	1	1	0	0	0	-1.750	0.099	0.539

23	1	1	1	1	1	1	1	1	0	0	-1.433	0.988	0.838
24	1	1	1	1	1	1	1	1	1	1	-0.519	0.673	0.750
25	1	1	1	1	1	0	0	0	0	0	-0.247	0.461	0.678

Subjects with pr<0,01 were misfit in this scalogram, and then it assumed that they did not deliver the useful information in this scalogram. The *Person-fit measurement* value would high if the subjects reported they had done the behaviour in certain items, it means they have already done the behaviour in previous items. For example, from table 7, subjects #2 reported that he/she ever been kissed, yet he/she did not report been holding hands or hugged. Hence, subject #2 misfit with this scalogram model, and would be excluded.

4. Conclusion

Item Response Theory (IRT) explain the interaction between persons and test items. It is not as in Classical Test Theory (CTT) that focused on the obtained score, IRT was independent to both sample and test items. This pattern produces a more accurate measurement, and the items could be calibrated. Rasch model was applied to examine the psychometric property of pre-marital sexual behaviour scalogram. The results show that this scalogram was an excellent assessment instrument to get information about adolescent's pre-marital sexual behaviour. The analysis of item calibration revealed that some of the items were misfit with the pre-marital sexual behaviour model. Those items probably already have out of date and should be replaced by the items that could describe adolescent's pre-marital sexual behavior along with the change in their lifestyle. Therefore, researches with the various approach are needed to construct the new assessment tools of pre-marital sexual behaviour.

References

Azwar, S. (2011). *Reliabilitas dan Validitas*. Pustaka Pelajar.

Byrne, J. H., Menzel, R., III, H. L. R., Eichenbaum, H., & Sweatt, J. D. (2008). *Learning and memory: a comprehensive reference*.

Carlson, J. E., & Davier, M. von. (2013). Contributions Series Item Response Theory. *ETS R&D Scientific and Policy Constributions Series*, *RR-13-28*(December), 79.

Lamb, R. L., Annetta, L., Meldrum, J., & Vallett, D. (2012). Measuring Science Interest: Rasch Validation of the Science Interest Survey. *International Journal of Science and Mathematics Education*, *10*(3), 643–668. https://doi.org/10.1007/s10763-011-9314-z

Meijer, R. ., & Sijtsma, K. (2001). Methodology review: evaluating person fit. *Applied Psychological Measurement*, *25*(2), 107–135.

Muis, K. R., Winne, P. H., & Edwards, O. V. (2009). Modern psychometrics for assessing achievement goal orientation: A Rasch analysis. *British Journal of Educational Psychology*, *79*(3), 547–576. https://doi.org/10.1348/000709908X383472

Pomeranz, J. L., Byers, K. L., Moorhouse, M. D., Velozo, C. A., & Spitznagel, R. J. (2008). Rasch Analysis as a technique to examine the psychometric properties of a career ability placement survey subtest. *Rehabilitation Counseling Bulletin*, *51*(4), 251–259. https://doi.org/10.1177/0034355208317317

Primé, D. R., & Tracey, T. J. G. (2010). Psychometric properties of the career clusters interest survey. *Journal of Career Assessment*, *18*(2), 177–188. https://doi.org/10.1177/1069072709354202

Sarwono, S. W. (2006). *Psikologi remaja*. Raja Grafindo Persada.

Sumintono, B., & Widhiharso, W. (2015). *Aplikasi Pemodelan Rasch pada Assessment Pendidikan*. Trim Komunikata Publishing House.

Vock, M., Köller, O., & Nagy, G. (2013). Vocational interests of intellectually gifted and highly achieving young adults. *British Journal of Educational Psychology*, *83*(2), 305–328. https://doi.org/10.1111/j.2044-8279.2011.02063.x

Winterstein, B. P., Ackerman, T. A., Silvia, P. J., & Kwapil, T. R. (2011). Psychometric properties of the wisconsin schizotypy scales in an undergraduate sample: Classical test theory, item response theory, and differential item functioning. *Journal of Psychopathology and Behavioral Assessment*, *33*(4), 480–490. https://doi.org/10.1007/s10862-011-9242-9

Wyse, A. E., & Mapuranga, R. (2009). Differential Item Functioning Analysis Using Rasch Item Information Functions. *International Journal of Testing*, *9*(4), 333–357. https://doi.org/10.1080/15305050903352040