A RASCH MODEL ANALYSIS ON TEACHERS’ INNOVATIVE BEHAVIOUR PSYCHOMETRIC ITEMS

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Abstract

The purpose of the study is to analyze the psychometric properties of a survey questionnaire, Malaysian Teachers’ Innovative Behavior Instrument (MTIB) using Rasch Measurement Model aided by Winstep software Version 3.73. The questionnaire was administered on 109 school teachers from Melaka. The data were analyses to examine the items functional accordingly from the aspect of items fit in measuring constructs, items polarity, unidimensionality, local independence and the reliability and separation of item and respondent. The Rasch analysis showed satisfying psychometric properties of MTIB after removal of some misfit ting items. Fit statistic evaluation discovered that a sum of 10 items were out of range and leaving only 20 items remaining that are appropriate to measure the four constructs of the innovative behavior in the MTIB. Further analysis with the remaining 20 items revealed that each PTMEA Corr is in positive values and met the assumptions of unidimensionality and local independence. Reliability and separation index were also within acceptable range. As for future research, it is recommended that different studies should be organized by using a various sample to generate much better, detailed and comprehensive information which can be represented more extensively.

Keywords: Innovative Behavior, Psychometric, Rash Model, Teacher, Instrument

I. Introduction

Innovation works as an essential role in the advancement of economic growth for every single country in the world. Innovation just not guarantees economic development, yet in addition also helps in securing sustainable competitiveness [XXIII]. Moreover, past research also shown that innovation appears to be a
determining factor for long-term success and survival of organizations in the era of global competition, and this applies to private and also public organizations [IV], [XV]. For organizations, innovations are of great importance to stimulate efficiency, effectiveness, and the development of new products and services. Therefore, organizations nowadays progressively anticipate and require their employees to participate innovation, changes and improvement at work. The development of innovations must always include contributions of individuals or employees within the organizations. This is because, in a process of some innovation development, employees play a pivotal role as the creative source of innovations. Without employees, innovations will not be occurred. For innovation to successfully achieve within organizations, employees initially must have the behavior towards innovations. As indicated by the past researcher, this sort of behavior is called innovative behavior or innovative work behavior. According to [XX], innovative behavior is the intended initiation and application, within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group or wider society. Employees' innovative work behavior today is deemed as the most substantial resource and asset in obtaining competitive benefit for the organizations [VIII], [X], [XI].

In education systems, the arrival of Industrial Revolution 4.0 (IR 4.0) era has transformed various things completely. Perspective on teaching and learning process had evolved differently from the past. Today’s learning process has undergone a shift as a result of global social and economic change. The learning goal has evolved to prepare the students to meet the demands of a very dynamic era, full of technological sophistication and very diverse information accessibility. Thus, it is crucial to enhance the condition and quality of the education in order to fulfil the challenging needs. It is generally acknowledged that the quality of an educational system mainly depends on the quality of the teachers [VII], [IX]. However, teachers’ responsibilities these days evolved from just teaching in a class to become more challenging each day. Nowadays, teachers need to become all-rounders individual namely from facilitators, mentors, researchers, and innovators in the teaching and learning process [I]. As the responsibilities keep growing day by day, some see that innovation can play a major role to help achieving the challenging teachers’ goal and objective in education system. Innovation in education involves something away from what teachers are doing typically and make a completely unique idea which can help themselves to do their work differently and more effectively. For example, innovation in education can facilitate to improve productivity, learning effectiveness and improve learning quality by producing much innovation such as newer pedagogical philosophy, procedural approach, instruction methods, teaching tool, or learning process that, when applied, will produces a substantial transformation in teaching and learning process, which may leads to improvement in students’ learning [XIX]. However, with the aim of ensuring that innovation in the education system is successfully implemented, teachers as pillars must have an attitude toward innovation. Teachers need to have innovative behavior to ensure that they can catch up with the current challenging environment in education system.

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Despite been recognized as essential aspect in improving education quality, research about teachers’ innovative behavior in Malaysian context is still inadequate [XXII]. More research needed to fully understand about innovative behavior among teachers in Malaysia. However, before conducting further research, there should be a valid and reliable instrument to access teachers’ innovative behavior in the field of Malaysian context. It is very crucial to study the validity and reliability to ensure and sustain the precision of the instrument from some imperfection and error. Although there are a great number of self-report instruments that can be adapt and already had been use within Malaysian context, yet there is no study to be found in examining existing instruments from psychometric properties of Rasch perspective. Therefore, this study will attempt to address this shortcoming by examining the psychometric properties of Malaysian Teachers’ Innovative Behavior Instrument (MTIB) using a Rasch Measurement Model in a sample of Malaysian teachers.

II. Methodology

This study used a survey technique with a set of questionnaires (MTIB) adapted from previous research namely [V], [XIV], [XVI], [XVII], [XVIII]. This adapted questionnaire comprising 30 items of five-point rating scale reflecting to four main constructs, specifically idea exploration, idea generation, idea promotion, and idea implementation [V], [XIV]. MTIB was used to assess the four constructs which contain idea exploration – IE (8 items), idea generation – IG (8 items), idea promotion – IP (7 items) and idea implementation – II (7 items). Items are quantitatively examined using WINSTEPS version 3.73 to assess the suitability of items.

MTIB was administered to a total of 109 teachers from 2 government schools in Melaka. 59 teachers are from government primary school, while 50 more others are from government secondary school. Both schools were classified as urban areas. The questionnaire was administered to the teacher involved in groups by the researcher himself. Respondents were given 15 minutes to answer the questionnaire before being collected by the researcher. Eventually, no single questionnaires were rejected as a result of incomplete and invalid responses. Respondents for this research consisted of 61 (55.9%) females and 48 (44.1%) males.

III. Results and Discussions

Fit Statistics

The Rasch Model’s fit statistics measuring how well the items fit the model’s expectations through the infit and outfit Mean Square (MNSQ) and ZSTD. According to [VI], the acceptable range for the infit and outfit of MNSQ is between 0.77 and 1.30 to confirm that the items are proper for measuring the constructs. If the infit or outfit MNSQ value is higher above the range, then it can be said that the item was confusing, while if the value is lower than below range, it indicates that the item is too easily anticipated by the respondents [XII]. For the ZSTD, the value should be within -2 to +2 [III], [XII]. However, if the outfit and infit MNSQ are accepted, the
ZSTD index can be ignored [XII]. In Rasch Fit statistic, if the condition is not met, then the item will be considered problematic and should be removed or having refined. Table 1 below shows all the item fit statistics.

Table 1: Item fit

| Item | Total score | Logits | S. E  | INFIT         | OUTFIT        |
|------|-------------|--------|-------|---------------|---------------|
|      |             |        |       | MNSQ | ZSTD | MNSQ | ZSTD |
| IE1  | 416         | -0.07  | 0.17  | 1.14 | 1.0  | 1.11 | 0.8  |
| IE2  | 416         | -0.07  | 0.17  | 0.90 | -0.7 | 0.85 | -1.1 |
| IE3  | 419         | -0.16  | 0.17  | 0.80 | -1.5 | 0.74 | -1.9 |
| IE4  | 391         | 0.64   | 0.16  | 1.33 | 2.2  | 1.45 | 2.8  |
| IE5  | 390         | 0.67   | 0.16  | 0.90 | -0.6 | 0.91 | -0.6 |
| IE6  | 409         | 0.14   | 0.17  | 1.49 | 3.1  | 1.42 | 2.6  |
| IE7  | 406         | 0.22   | 0.17  | 1.20 | 1.4  | 1.17 | 1.2  |
| IE8  | 431         | -0.53  | 0.18  | 0.80 | -1.4 | 0.80 | -1.4 |
| IG1  | 419         | -0.16  | 0.17  | 0.94 | -0.4 | 0.92 | -0.5 |
| IG2  | 328         | 2.16   | 0.15  | 0.59 | -3.5 | 0.64 | -2.9 |
| IG3  | 430         | -0.5   | 0.18  | 0.72 | -2.2 | 0.66 | -2.6 |
| IG4  | 425         | -0.34  | 0.18  | 0.88 | -0.9 | 0.81 | -1.4 |
| IG5  | 450         | -1.14  | 0.18  | 0.87 | -0.9 | 0.82 | -1.2 |
| IG6  | 435         | -0.65  | 0.18  | 1.02 | 0.2  | 0.98 | -0.1 |
| IG7  | 400         | 0.39   | 0.17  | 1.52 | 3.2  | 1.56 | 3.4  |
| IG8  | 420         | -0.19  | 0.17  | 1.11 | 0.8  | 1.08 | 0.6  |
| IP1  | 427         | -0.4   | 0.18  | 0.86 | -1.0 | 0.85 | -1.0 |
| IP2  | 416         | -0.07  | 0.17  | 0.86 | -1.0 | 0.82 | -1.3 |
| IP3  | 430         | -0.5   | 0.18  | 0.74 | -2.0 | 0.69 | -2.3 |
Based on Table 1, analysis found that 10 items aren’t within the acceptable range and have to be considered to refined or removed. 5 items surpass the value of 1.30 namely IE4, IE6, IG7, II2, and II6, while another 5 made a value less than 0.77 that is IE3, IG2, IG3, IP3, and IP4. As a result, from this diagnosis, all 10 items were dropped after taking into consideration at the needs of researchers and expert opinions. All these items will be excluded from other diagnosis in Winsteps and thus, there will be only 20 items for further analysis.

**Item Polarity**

Item polarity is defined by examine the Point Measure Correlation (CORR PTMEA) to test the extent to which the construction of constructs to achieve its goal. If the correlation coefficient is positive, it shows the capability of the item to measure the constructs is valid (Linacre, 2002). While in the other hand, if the value of PTMEA CORR is negative or ‘nearly zero’, it shows that the relationships between response item and the construct are contradict and not consistent [III], [XIII]. According to [XXI], the acceptable value of PTMEA CORR is positive and above 0.30. Therefore, if there are any items that do not fulfil these criteria, then it should be refined or removed because it shows the item is not point and address to the question or may be too hard or confusing for the respondent to answer. Table 2 below shows all 20 items PTMEA CORR value.
Table 2: Point Measure Correlation Value

| Item | PTMEA Corr | Exp |
|------|------------|-----|
| IE1  | 0.60       | 0.63|
| IE2  | 0.67       | 0.63|
| IE5  | 0.70       | 0.65|
| IE7  | 0.57       | 0.64|
| IE8  | 0.65       | 0.62|
| IG1  | 0.72       | 0.63|
| IG4  | 0.66       | 0.62|
| IG5  | 0.62       | 0.60|
| IG6  | 0.55       | 0.62|
| IG8  | 0.59       | 0.63|
| IP1  | 0.69       | 0.62|
| IP2  | 0.77       | 0.63|
| IP5  | 0.69       | 0.64|
| IP6  | 0.73       | 0.63|
| IP7  | 0.68       | 0.63|
| II1  | 0.64       | 0.63|
| II3  | 0.69       | 0.61|
| II4  | 0.62       | 0.61|
| II5  | 0.63       | 0.64|
| II7  | 0.73       | 0.63|
Based on Table 2, diagnosis shows that all the PTMEA CORR is within positive values and above 0.30 as suggested. This indicates that all 20 items remaining in MTIB are going in the same direction with the construct, able to measure the constructs and does not conflict with each construct that being measured.

**Unidimensionality**

Assessing unidimensionality is essential to ensure MTIB is measuring the intended objectives. Rasch analysis applies the Principle Component Analysis (PCA) of the residuals which measures the extent to which the diversity of the instruments measures what should be measured. The result of the PCA analysis can be seen in Table 3 below.

| Table 3: Standardized Residuals of the instrument |
|-----------------------------------------------|
| **Empirical** | **Modeled** |
|----------------|-------------|
| Total raw variance in observations | 37.1 | 100.0% | 100.0% |
| Raw variance explained by measures | 17.1 | 46.1% | 46.8% |
| Raw variance explained by persons | 10.2 | 27.5% | 27.9% |
| Raw variance explained by items | 6.9 | 18.6% | 18.9% |
| Raw unexplained variance (total) | 20.0 | 53.9% | 100.0% | 53.2% |
| Unexplained variance in 1st contrast | 2.8 | 7.5% | 14.0% |
| Unexplained variance in 2nd contrast | 2.3 | 6.3% | 11.7% |
| Unexplained variance in 3rd contrast | 2.1 | 5.7% | 10.5% |
| Unexplained variance in 4th contrast | 1.6 | 4.3% | 7.9% |
| Unexplained variance in 5th contrast | 1.3 | 3.4% | 6.4% |

As a result, Table 3 shows that the observed raw variance is 46.1% and approximates the expected model at 46.8%. This variance explained by the measures was way above 40%, therefore indicates a strong principal measurement dimension [XII]. The level of noise measured, or the variance which was not explained in the first contrast shows a 7.5% value which is less than 15% and thus, considered to be very good and sufficient [VI]. The Eigenvalues of 2.8 also indicates that there is no significant second dimension in the item [XII]. Taken together, the PCA of the Rasch Model residual results indicated that the underlying items in the MTIB are meets the unidimensionality assumption and assessing a unidimensional measurement model.
This strongly suggests that MTIB would be able measure what it was intended to measure effectively.

**Local Independence**

The value of local freedom can give valuable information about the dependencies of the items in the instruments. A good item is not dependent on each other. To check the value of local independence using Rasch, Standardized Residual Correlation test should be performed to verify if any pair of items is confusing and overlapping with each other. The range that meets minimum requirements is a correlation value of less than 0.7 \([XII]\). But, if the value is below than 0.30, than it is considering being better \([II]\). (Balsamo, Giampaglia, & Saggino, 2014). The results of the Standardized Residual Correlation test can be seen in Table 4 below.

**Table 4: Local Independence**

| Correlation | Item - Construct         | Item - Construct          |
|-------------|--------------------------|---------------------------|
| 0.55        | IP2 – Idea Promotion     | II7 – Idea Implementation |
| 0.46        | IE5 – Idea Exploration   | IE7 – Idea Exploration    |
| 0.43        | IE1 – Idea Exploration   | IE2 – Idea Exploration    |
| 0.42        | IP2 – Idea Promotion     | II1 – Idea Implementation |
| 0.41        | IE2 – Idea Exploration   | IE7 – Idea Exploration    |
| 0.37        | IG6 – Idea Generation    | II5 – Idea Implementation |
| 0.36        | IE1 – Idea Exploration   | IE7 – Idea Exploration    |
| 0.35        | IE1 – Idea Exploration   | IE5 – Idea Exploration    |
| 0.34        | IG5 – Idea Generation    | IG6 – Idea Generation     |
| -0.41       | IG5 – Idea Generation    | IP6 – Idea Promotion      |

Based on the result, it can be said that MTIB items are fulfil the assumption of local independence. The findings show that the items in this instrument are not confusing and do not overlap with each other with the highest correlation value is just about 0.55 between IP2 and II7. However, there are four pairs with acceptable correlation value that should be given an attention. From the results, it shows that these two pair which is from different construct does have some correlation. Therefore, it should be check manually whether both pair are confusing or linking to each other.
Reliability and Separation Index

Rasch analysis produces reliability and separation index for both items and individual. Individual separation index reveals the number of strata capabilities identified in the sample group, while the item separation index shows the separation of item difficulty level. According to [III], [XII], the value of both item and individual separation index should be above 2 to be treated as good. While for the reliability, the minimum acceptable value of the index is above 0.66 [VI]. Table 5 and 6 shows the details about the reliability and separation index for both the person and items.

Table 5: Summary of person statistics

| Raw Score | Count | Measure | Model Error | Infit | Outfit |
|-----------|-------|---------|-------------|-------|--------|
| Mean      | 113.5 | 30.0    | 1.83        | 0.33  | 0.99   |
| Standard Deviation | 14 | 0.0 | 1.51 | 0.04 | 0.62 |
| Max       | 147.0 | 30.0    | 6.55        | 0.63  | 2.89   |
| Min       | 66.0  | 30.0    | -2.14       | 0.25  | 0.13   |
| Real RMSE | 0.37  | True SD | 1.47        | Person Reliability | 3.97 |
| Model RMSE | 0.33  | True SD | 1.48        | Person Reliability | 4.41 |

Person Raw Score-To-Measure Correlation = .99
Cronbach Alpha (KR-20) Person Raw Score Reliability = .99

Table 6: Summary of item statistics

| Raw Score | Count | Measure | Model Error | Infit | Outfit |
|-----------|-------|---------|-------------|-------|--------|
| Mean      | 420.1 | 109.0   | -0.20       | 0.17  | 0.99   |
| Standard Deviation | 13.3 | 0.0 | 0.40 | 0.00 | 0.13 |
| Max       | 450.0 | 109.0   | 0.67        | 0.18  | 1.22   |
| Min       | 390.0 | 109.0   | -1.14       | 0.16  | 0.80   |
| Real RMSE | 0.18  | True SD | 0.36        | Separation | 2.02 |
| Model RMSE | 0.17  | True SD | 0.36        | Separation | 2.09 |

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UMean = 0.000 UScale = 1.000
Item Raw Score-To-Measure Correlation = -1.000

The findings reveal that the individual separation index is 3.97 and the item separation index is 2.02 which is considered as good. Technically, this result shows that the respondents can be categories into four strata of ability and the item can be classified into two groups of difficulties. For the reliability index, it is found that the person reliability value is quite decent at 0.94, while the reliability index for the items achieved an acceptable value at 0.80. Both values indicate that the person and item in this research are good and do have reliability.

V. Conclusion

Overall, this study had shown the strength of the Rasch measurement model which is established on the Item Response Theory in assessing the psychometric properties of MTIB. Different diagnosis procedures were applied to assess the psychometric properties of the MTIB. With the examination through Rasch analysis, it was discovered that 10 out of 30 items were unfit, leaving only 20 items remaining in the MTIB. Further analysis with the remaining items had found that the validity and reliability of the instrument are acceptable for measuring the innovative behavior of school teachers. Additionally, the result did show that the instrument has also fulfilled other psychometric properties required for an acceptable instrument. These indicate that MTIB is an indeed innovative behavior instrument that can be used to measure the level of behavior towards innovation among school teachers in Malaysia. As for future research, it is recommended that different studies should be organized by using a bigger scope and various samples to generate a much better, detailed and comprehensive information which can be represented more extensively.

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