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Application of Rasch Model Analysis in Calibrating Undergraduate Challenges at Malaysian Universities

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Abstract: The purpose of this study is to calibrate the challenges faced by undergraduates in Malaysian universities. The challenges are divided into four aspects, namely, academics, personal, social and career as well as the infrastructural needs of universities. A total of 360 undergraduates from 2 local public universities participated in this study. Responses from the 30 items questionnaire were calibrated using the Rasch model analysis so as to determine the most important challenges and how different these challenges are from each other. The undergraduates agreed that internet connection is the most important challenge (measure = -1.99 logit), followed by the quest for academic excellence (mean = -1.24 logits) and missing their family back home (mean = -1.18 logits). Based on the equal interval scale of the Rasch model calibration, this study obtained the following information: internet connection (measure = -1.99 logit) is about 2 times more important than the challenge to secure job after graduation (measure = -1.02 logit). In contrast, securing job after graduation is 2 times more important than challenges related to transport system (mean = -01.51 logits).

Key words: Academic, infrastructure, personal, Rasch model, social, university challenges

INTRODUCTION

Undergraduates enrolling into Malaysian universities may experience various difficulties. This is due to variety of challenges that they need to confront, especially in regards to teaching, academic requirements, relations with members of the university community, adapting to new faculties as well as the need to adapt to new relations among students (Thawabieh and Qaisy, 2012). Failure to meet the challenges is considered one of the most important factors in explaining their failure to perform as expected (Muhmad *et al*., 2015). Therefore, it is not surprising that many studies are dedicated to understanding the challenges faced by undergraduates at the university.

Undertanding graduate challenges can be facilitated from the framework provided by Havigust. According to the theory, every individuals will undergo various transitional phases in their life. At every phases, they need to require specific knowledge and skills before able to proceed to the next phase. With regards to life at university, the undergraduates need to deal with challenges mainly related to academic and non-academic adjustments. Those who are able to overcome the challenges are able to develop resilience that highly likely will see them not only succeed at the university but also at workplaces.

In Malaysia, numerous studies have been carried out that focus on challenges among university undergraduates. Based on literature, the challenges among undergraduates in Malaysia can be divided into four main categories. Firstly, academic challenges are considered as highly important. It involves issues related to teaching and learning. Among such issues are the inability of the university to provide enough information to students regarding academic matters high expectations from lecturers (Baharudin *et al*., 2013) and inability to understand lecture. Meanwhile, personal challenges deal with issues such as time management, finance, family as well as the learning of English (Abdullah *et al*., 2010). Social and career challenges involve issues associated to the relationship of undergraduates with the university community such as culture shock and the feeling of insecurity. Studies have shown that they are also worry about securing their dream jobs (Shafeq and Hairiza, 2001). Lastly, a growing number of literature also identify university's infrastructure as an important challenge faced by undergraduates. Facilities such as library, hostel, toilet, health, signage and recreational places have been reported as below standard (Safahieh, 2007).

Nevertheless, the focus of most of the studies are on first year undergraduates, especially in regards to their

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adjustment to university life. However, we argue that university challenges are not unique to first year undergraduates only. Second, third and even final year undergraduates are also faced challenges to adapt to university's life. Therefore, the identification of specific challenges may provide information especially in terms of providing help so that they can be equipped with both academic and non-academic requirements for the demanding labour market. In addition, information gathered based on infrastructure, may help universities improve upon their facilities.

Calibration with Rasch modelanalysis: Calibration refers to a process of estimating test parameters by transforming raw scores from the responses to challenges (Wright and Masters, 1982). It brings about the ordering of a particular construct on a measured scale. Calibration of heat provides a scale which is define in °C as in a thermometer while calibration of length resulted in a scale defined in meter unit seen in a typical ruler. Calibration of university challenges therefore is defined as a process of ordering the challenges and transfer the information from the challenges into a scale. Calibration is important process in measurement of especially an unobservable construct, since it does not only assign numbers but also able to determine the differences between challenges. Nevertheless, calibration of psychological constructs such as university challenges is not as straight forward as calibration of physical construct such as length. This is because psychological constructs are unobservable. As such the calibration of psychological construct is conducted indirectly using tools such as questionnaire. One of the procedure for calibrating the challenges is by employing the rasch modelanalysis (Linacre, 2005). This modelis from a family of modern test theories called the item response theory that relates important parameters in the measurement of a construct (Crocker and Algina, 1986). In the Rasch model, the probability of a person n with ability a correctly answered the item i with difficulty δ, P (θi) is given by; $P_{ni} = \exp(\beta_n-\delta_i)/1+\exp(\beta_n-\delta_i)$ (Bond and Fox, 2007). For the Likert-scale responses, the probability of answering correctly is defined as the ability of a particular respondent to agree with the item. Therefore, a person who provides more positive responses (agree/strongly agree) is considered more able as compared with students who give many negative responses (disagree/strongly disagree). The score from calibration process is identified as "measure" and defined in logits unit. Apart from the calibration of a person's ability, the Rasch model calibration also estimates the item difficulty parameter.

Measures from Rasch model calibration is essential in measurement. This is because the measure, estimated from the calibration process, possess equal-interval property as in a thermometer or a ruler. That is a student with ability of 2.0 logits is always twice more able than able than student with 1.0 logits ability. Similarly, Item a with measure of 2.0 logits is always 2 times more difficult than item B of 1.0 logits. As such the calibration does not only provide differences between the two measures but evidence on how much they are different. Within the context of this study, an undergraduate with ability of 2.0 logits is considered as more able to face the challenges compared to his or her colleague with estimated ability of 1.0 logits. Meanwhile, an item (challenge) of 2.0 logits difficulty is in fact twice as more important challenges compared to item with 1.0 logits difficulty. It should be noted that item (challenge) measure calibration is a prime interest in this study, based on its purpose to identify the importance of a set of university challenges to the undergraduates.

Despite the fact that Rasch modelanalysis provides important information on the measured construct, its modeling comes with strong assumptions. Two important assumptions in the Rasch Model analysis that must be met are the data must fit the model's expectation and the construct being measured must pose unidimensionality property (Linacre, 1998). Model-data fit is an important aspect of any modelling process since it serves as a quality control that shows how good the measurement been made. Analysis of fit helps detect discrepancies between the Rasch model's expectation and the data collected. Model-fit issues are usually addressed by investigating the fit statistics such as the infit and outfit, Mean-Squares (MNSQ). Several guidelines are available in determining the acceptable MNSQ values. Wright (1994) and Bond and Fox (2007) both suggest the value of 0.6-1.4 logits while according to Smith *et al.* (2008) the values of between 0.7-1.3 logits are also frequently used. Note that the expected value of both infit and outfit MNSQ are 1.00 logits. Therefore, the values of 0.7 logits indicate that the measurement of the particular construct is also inclusive of particular item is also measuring about 30% 'noise'.

On the other hand, unidimensionality assumes that items in a test, measure a single construct (Wright and Masters, 1982). In Rasch model analysis, the assumption of unidimensionality is investigated using the Principal Component Analysis (PCA) of residuals procedure. In this procedure, the first (main) construct has been extracted out and the purpose is to identify whether the second construct is present from the residuals. According to Eakman (2012), the unexplained variance

from the second construct extracted from the procedure should be <10%. Also, according to Linacre (2005) if the eigenvalue extracted from the PCA of residual is >2.0 then it can provide evidence the presence of second construct which confounded with the first construct.

MATERIALS AND METHODS

The study sample consists of 360 undergraduates from 2 local public universities (male = 108, female = 252). A 30-item questionnaire was developed to measure the challenges faced by undergraduates in regards to academics (9 items) personal (8 items) social and career (6 items) and infrastructure (7 items). Majority of the undergraduates (69.4%) were in their second year of study while the rest were in their third year. In this study, the rasch model Software, namely, winsteps 3.63 was employed to calibrate the challenges. The software employs the Joint Maximum Likelihood Estimation (JMLE) procedure to calibrate and measure both item difficulty and ability estimation. A more comprehensive explanation is beyond the scope of this study but can be found in Linacre (1998). The statistics of item measure and its standard error were used to describe the information provided by the Rasch model calibration. Items (challenges) with high measure values means that the undergraduates had difficulty agreeing with the items. In contrast, items with low measure means that the undergraduates had less difficulty agreeing with the items. Thus items with low difficulty measures were considered more important to the undergraduates.

RESULTS AND DISCUSSION

The infit MNSQ values for all 30 items ranged from 0.64-1.36 logits while outfit MNSQ values ranged from 0.65-1.39 logits which is within the acceptable range (Bond and Fox, 2007; Wright *et al*., 1994). Thus, it confirms that the data collected for each item is within expectation of the model. In addition, the unexplained variance from the second construct extracted was 7.5%. As such the unidimensionality assumption is also fulfilled (Eakman, 2012). Table 1 shows the statistics for each of the undergraduate's university challenges in logits unit. It shows item's difficulty measures as well as the Standard Error (SE) that provides evidence on the accuracy of the measurement.

The poor internet connection in the university (-1.99 logits) was endorsed by the undergraduates as the most important challenges. The result is rather not unexpected since undergraduates need a good internet connection to complete their learning tasks, especially as universities in Malaysia encourage both students and lecturers to use the e-Learning platform for information sharing which is based on the Malaysian e-Learning policy. In addition, good internet connection is required for their personal purposes such as checking of emails and connecting to social media such as Facebook, WhatsApp and Twitter, etc. The present study also reports that the challenge of getting good Cumulative Grade Points Average (CGPA) (-1.24 logits is also considered as an important for university undergraduates in this study. This finding concurs well with other previous studies such as by Roselind and Mapolisa and Mafa. The positive side of this finding is that academic excellence is still considered as the prime purpose of for Malaysian undergraduates even though they have to deal with new learning environment which is very distinct from the pre-university days.

In addition, missing family (-1.18 logits) which is usually associated with first year undergraduates completed the top three of the most important challenges for the undergraduates. In contrast, most of the undergraduates disagreed that they have chosen a wrong course in the university (1.94 logits) even though this challenge is considered as important for first year undergraduates in Malaysia. The finding also shows that the claim that the lecture halls are not up to standard (1.94 logits) is not an important challenge for the undergraduates even though it has been documented otherwise as in the study of Alavi and Mansor (2011) as well as Christina Andin@Nur Qistina and Irwan. Also challenges related to difficulty to communicate with friends and lecturers (0.95 logits) is also regarded as the three least important challenges in this study.

As mentioned earlier, Rasch model calibration provides equal-interval measure of the measured construct. Therefore, it can be inferred that challenge related to internet connection (measure = -1.99 logits) is about 2 times more important for the undergraduates compared to the challenge to secure job after graduation (measure = -1.02 logits). Also, securing job after graduation is 2 times more important than challenges related to transport (measure = -0.51 logits). The results are certainly need to be look further since the information can be used in many meaningful ways especially by university authorities to provide interventions as well as counselling programs so that the undergraduates are able to cope better. Besides calibration of item difficulty measures, winsteps 3.57 also provide graphic representation of item difficulty and ability parameters as shown in Fig. 1. Figure 1, named wright map shows ordering of item/challenge difficulty, indicated by S1-S30

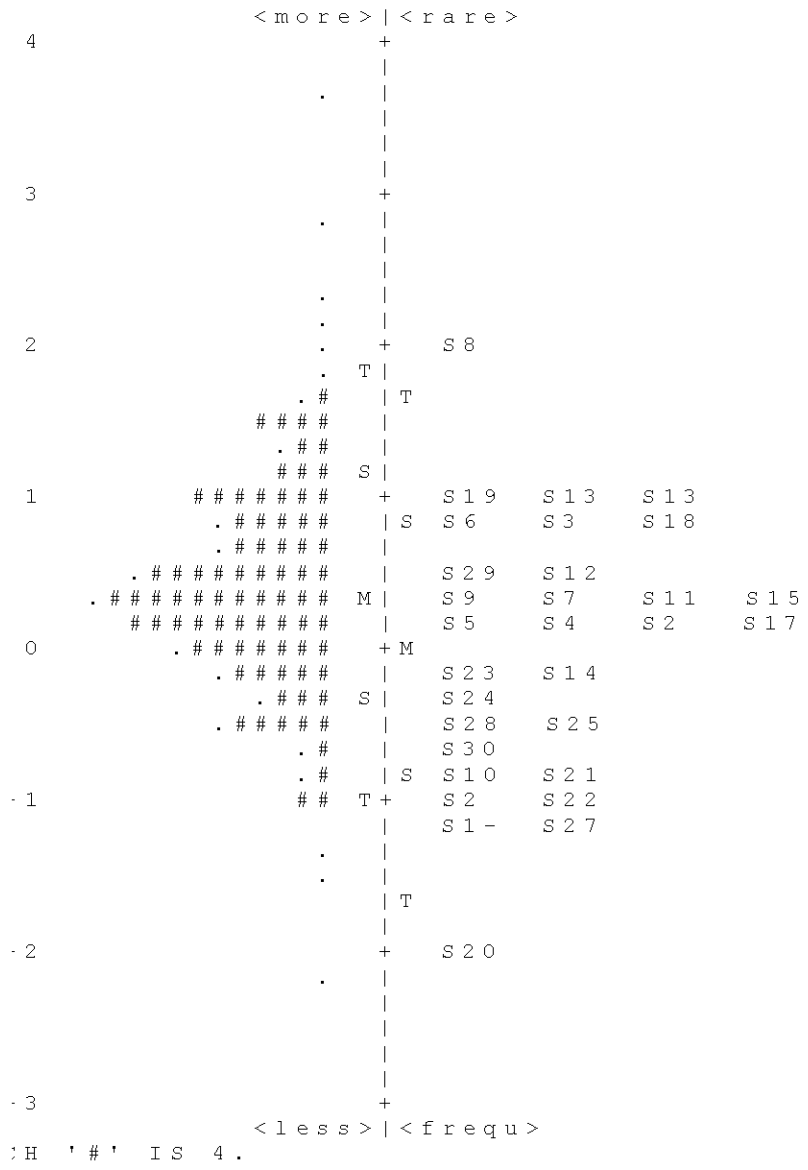

Fig. 1: The wright map

Table 1: Statistics of the item difficulty parameter estimation (logits)

Item No.	Measure	SE	Infit MNSQ	Outfit MNSQ	Item label
S20	-1.99	0.09	1.08	1.01	I: Poor internet connection
S1	-1.24	0.08	1.14	1.11	A: Academic excellence
S27	-1.18	0.08	1.32	1.36	P: Missing family
S22	-1.02	0.08	0.84	0.89	I: No platform to voice out issues
S26	-1.02	0.08	1.20	1.22	CS: Insecure career
S21	-0.88	0.08	1.07	1.11	I: Health facility
S10	-0.80	0.08	1.01	1.01	A: Tight time table
S30	-0.60	0.08	0.88	0.88	CS: Inferiority complex
S25	-0.51	0.07	1.14	1.15	I: Transport challenges
S28	-0.44	0.07	1.03	1.02	CS: Wrong expectations
S24	-0.31	0.08	1.36	1.39	I: Unconducive hostel
S23	-0.20	0.07	1.30	1.35	I: Faculty management
S14	-0.14	0.07	0.94	0.93	P: Dwelling with other things
S2	0.10	0.07	1.00	1.00	A: Lack of time to study
S5	0.19	0.07	0.64	0.65	A: Ineffective learning style

Table 1: Continue

Item No.	Measure	SE	Infit MNSQ	Outfit MNSQ	Item Label
S4	0.22	0.07	0.98	0.97	A: Access to learning materials
S17	0.22	0.07	1.18	1.19	P: Financial challenges
S9	0.27	0.07	1.18	1.19	A: English acquisition
S7	0.37	0.07	0.81	0.83	A: Difficult to concentrate in class
S15	0.38	0.07	0.79	0.79	P: Moody
S11	0.41	0.07	0.70	0.70	CS: Difficulty to gain lecturer's attention
S29	0.43	0.07	0.99	0.99	CS: Difficulty to gain friend's attention
S12	0.47	0.07	0.79	0.79	P: Lack of confidence
S18	0.77	0.08	0.88	0.88	P: Other personal problems
S3	0.81	0.08	0.65	0.65	A: Could not understand lecturers
S6	0.89	0.08	0.86	0.86	A: Not enough place to study
S16	0.93	0.08	0.91	0.90	P: Afraid to try new things
S13	0.95	0.08	0.99	0.98	P: Afraid to communicate
S19	0.97	0.08	1.12	1.12	I: Unconducive lecture hall
S8	1.94	0.08	1.36	1.35	A: Wrong choice of courses
Mean	0.00	0.08	1.00	1.01	
SD	0.84	0.00	0.20	0.20	

as well as ordering of the undergraduates (indicated by "#" which each # represents 4 undergraduates) on the measured scale. The items at the top of the line were more difficult to agree with the undergraduates at the top of the line were more able to cope with the challenges. As we go down the line, the items became easier to agree with and the undergraduates demonstrate less ability. The letters "M" on the scale represent the mean measures for both item difficulty and undergraduate's ability to cope with the challenges. Meanwhile, the letter "S" and "T" indicate one and 2 standard deviations for both parameters, respectively.

Overall, the instrument is able to target the undergraduates well based on small difference between item difficulty (mean = 0.00 logits, SD = 0.58 logits and undergraduate's ability (mean = 0.39 logits, SD = 0.70 logits). The items are also well distributed across various undergraduate's ability. Nevertheless, one important observation is that there are two significant gaps between subsequent items shown by the Wright map, namely, between S8 (1.04 logits) and S (0.97 logits) and S (-1.99 logits) and S1 (-1.24 logits). These gaps show evidence of construct under-representation that can be a treat to construct validity of the measurement made. In other words, there are other important aspects of the construct that have not being measured by this instrument. Therefore, in order to improve the instrument, more items should be added to capture these missing important aspects (Fig. 1).

CONCLUSION

The purpose of present study is to calibrate undergraduate's challenges at Malaysian universities. In conclusion, 2 important findings can be derived from this study. Firstly although, there are challenges that are unique to first year undergraduates, some of the challenges were also experienced by second and third year undergraduates as well. Secondly, Rasch model analysis was not only able to calibrate the challenges based on their importance but provided information on how a challenge is different from other challenges. These findings are valuable to the respective universities management in providing conducive learning for their undergraduates not only to strive for academic excellence but also for the acquisition of important skills essential to perform well in the challenging and unpredictable labour market.

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