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Research paper

Measuring Well-being among Engineering Undergraduates using Rasch Model Analysis

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Abstract

The purpose of this study is to calibrate undergraduates' well-being. 378 engineering undergraduates provide responses for this study. An 8-item Flourishing Scale is employed to gauge the responses using the Rasch model analysis. Results show that one item need to be dropped since they did not meet the Rasch model's expectations. Analysis on the remaining seven items showed that the undergraduates were least able to contribute to the happiness and well-being of others. In contrast they somewhat have positive well-being by endorsing that they have a purposeful and meaningful life. In addition, we discuss how to the findings might be helpful for university stakeholders to plan effective interventions for the undergraduates.

Keywords: *Rasch model, mathematics, 14 years-old, item difficulty, students' ability.*

1. Introduction

Malaysian students that acquire university education are future leaders. Therefore academic success is regarded as the ultimate goal in their university life. Nevertheless, life as undergraduates is never easy. They constantly face the stresses of achieving success in their academic goals, as well as other mental and social challenges ([14]; [3]). Life in the university environment presents a variety of responsibilities and challenges. Previous studies reported some undergraduates' challenges such as insufficient financial resources to meet their needs [15], heavily burdened by assignments, exams and presentations [1], conflict with peers and lecturers [21], as well as concerns about career prospect and their future as a whole [27]. Some may considered these challenges as trivial and common, however these challenges could be the main reason and primary source of our undergraduates' stress and anxiety, which has the potential to put them at significantly higher risk of mental health problems (Ansari et al., 2011; Stallman, 2010).

Most of our undergraduates may able to handle the challenges appropriately; however in the number of cases these challenges may have a serious impact on the undergraduates' psychological well-being. Most of the studies regarding students' adaptation to challenges has concerned its impact on academic performance, with little focus on psychological well-being [24].

Psychological well-being can be defined briefly as an individual personal growth, development potential and purposes [12]. It is thought to represent optimal human functioning [11]. In order for undergraduates to achieve their life goals and obtain academic success, it is important to be in a psychologically healthy condition [35]. According to [13], stressful atmosphere may create and elevate psychological distress and reduce undergraduates' academic performance. In the contrary, experiencing high levels of psychological well-being is considered to be a central criterion of positive mental health [30] and have been shown to predict students' attitudes and better academic performance [32].

Therefore, it is not surprising that psychological well-being of university students has become an important research endeavour [24] that increasingly gaining attention in recent studies. Even so, most of previous studies focus on the measurement of psychological well-being at the construct level. That is, the measurement yields a score that describes the psychological well-being construct as a whole. The score is further used in the correlation or regression analysis with other related psychological constructs. For example, a study by [31] shows that psychological well-being was correlated positively with problem solving coping and negatively with avoidance strategy. [35] have meanwhile found that students with high score of psychological well-being, are also carrying task oriented coping strategy. These students also have medium to high level of academic performance.

Apart from that, the literature lacks studies that focus on Malaysian engineering undergraduates. The educational period in engineering schools is always viewed as a highly demanding and stressful learning environment [29], in which the presence of depression, anxiety and stress among the students has been reported [17]. In addition, the literature also lacks studies that identify individual domain of psychological well-being that needed improvement. In other words, we need more studies that focusing on the measurement of psychological well-being at the item level. This is important so that the information can be used by the relevant stakeholders to conduct interventions at micro level, aiming for improving the overall psychological well-being of our undergraduates. One way to do this is by calibrating the individual items of the measurement scale using the Rasch measurement model approach.

Because of that, this study is aimed to measure the engineering undergraduates' psychological well-being by calibrating the individual items using Rasch model. Calibration is simply defined

as a process transforming raw scores from the responses in a particular instrument to challenges (Wright & Masters, 1979). The purpose is to estimate the test parameters, which in turns, provide information of the construct. Calibration brings about the ordering of a particular construct on a measured scale. For example, 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 (m) unit seen in a typical ruler. Calibration of psychological well-being, therefore is defined as a process of ordering the items and then transfer the information into a measured scale.

2. Materials and Method

Sample: The sample consisted of 378 engineering undergraduates from two public universities. Table 1 shows the demographic information of the sample. Data were collected during lectures to ensure good returns. All participants were fully informed regarding the aim of this study as well as the anonymity and confidentiality of the survey. Therefore the participation were fully decided in a voluntary manner.

Table 1: Demographic information of the sample.

Demographic	N	%
Gender		
Male	74	19.6
Female	304	80.4
Ethnic		
Malay	253	66.9
Chinese	93	24.6
Indian	18	4.8
Others	14	3.7
Year of Study		
First	103	27.2
Second	123	32.5
Third	128	33.9
Final	24	63

Instrument: This study employed the 8-item Flourishing Scale [11]. This scale describes human functioning with regard to individual fulfilment or self-actualization in eight important aspects: (1) meaning and purpose, (2) supportive and rewarding relationship, (3) engaged and interested, (4) contribution to the well-being of others, (5) competency, (6) self-acceptance, (7) optimism, and (8) being respected. Therefore, Flourishing Scale is a very brief, yet reasonably comprehensive scale to measure university students' psychological well-being. The response are gauged from a 6-point Likert scale of Strongly Disagree-Disagree-Quite Disagree-Somewhat Agree-Agree-Strongly Agree pattern.

Data analysis: In this study, calibration of the well-being items was conducted through Rasch model measurement framework using a software called WINSTEPS 3.63. The model relates two important parameters in the measurement of a construct, namely, the item difficulty and the person ability (in logits unit) the mathematical equation. More specifically, the Rasch model specifies that the probability of a person *n* with ability β correctly answered the item *i*, with difficultyδ, P (θ*i*) is given by the following equation [4]:

$$P(\theta_{ni}) = \frac{\exp(\beta_n - \delta_i)}{1+\exp(\beta_n - \delta_i)} \quad (1)$$

The statistics of item measure and its standard error were used to describe the information provided by the Rasch Model calibration. Item with high measure values indicates that the undergraduates had difficulty agreeing with. It represents aspects which the undergraduates are not happy with. Meanwhile, items with low measure demonstrates aspect that the undergraduates are happy with.

Even though Rasch model analysis provides avenue for richer interpretation of a particular construct, the modeling comes with two strong assumptions. Firstly, like any other modelling procedure, the data collected must fit the Rasch model's expectation and secondly, the construct must pose unidimensionality property [19]. In WINSTEPS 3.63, the model-data fit assumption is addressed through two fit statistics, namely, the infit and outfit, mean-squares (MNSQ). Wright and Linacre (1994) suggest the acceptable value of 0.6 – 1.4 for both statistics. Since the expected value of both infit and outfit MNSQ are 1.00, this guidelines allows 40% discrepancies in the data collected. Unidimensionality means that items in a test are measure a single construct [36]. 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 [18], the variance explained extracted from the first construct should be more than 40%to ensure unidimensionality assumption is fulfilled.

3. Results

Rasch model assumption: Result from Rasch model calibrations showed that Item 3 (*I am engaged and interested in in my daily activities*) did not meet the model's expectation based on the values of infit and outfit MNSQ of 1.80 and 1.84 respectively. As such, this item was dropped and the data was re-analysed. Result from Rasch model calibrations showed that all the remaining items showed acceptable range of infit and outfit MNSQ of 0.6-1.4. Thus, it confirmed that the data collected for each item was within expectation of the model. Meanwhile, the variance explained from the PCA of residuals 58.5%, was better than the intended 40%. As such, both the model-data fit and unidimensionality assumption was fulfilled.

Rasch calibration: As showed Table 2, the undergraduates endorsed that Item 4 (*I actively contribute to the happiness and well-being of others*) as aspect in well-being that they were most difficult to agree with, based on its highest measure of .58 logits. This is followed by Item 8 (*People respect me*, measure = .54 logits) and Item 5 (*I am competent and capable in the activities that are important to me*, measure = .38 logits). Meanwhile at the lower end of the table, the undergraduates are happy with Item 1 (*I lead a purposeful and meaningful life*, measure =-.65 logits) followed by Item 2 (*My social relationships are supportive and rewarding*, measure = -.45 logits).

Table 2: Item measure statistics

No	Item	Raw score	Measure (logits)	Standard Error	Infit MNSQ	Outfit MNSQ
1	I lead a purposeful and meaningful life	1684	-.65	.08	1.16	1.07
2	My social relationships are supportive and rewarding	1656	-.45	.08	.97	.91
3	I am engaged and interested in my daily activities	Deleted				
4	I actively contribute to the happiness and well-being of others	1502	.58	.08	1.21	1.20
5	I am competent and capable in the activities that are important to me	1532	.38	.08	.93	.94

6	I am a good person and live a good life	1621	-.21	.08	.94	.87
7	I am optimistic about my future	1616	-.18	.08	.83	.80
8	People respect me	1508	.54	.08	1.01	1.03
Mean		1588.4	.00	.08	1.01	.98
SD		68.3	.46	.00	.12	.12

SE = Standard error, SD = Standard deviation

4. Discussions and Conclusion

Item 4 (*I actively contribute to the happiness and well-being of others*) as aspect in well-being that the undergraduates were most difficult to agree with. Unwillingness to agree with this statement raises questions about our undergraduates' social integration, connections and being cared about and supported by others [16]. In other words, undergraduates are seen to be somewhat individualistic in their life at universities. They are more concerned with their own well-being compared others. This finding is a major concern for engineering undergraduates. Some contributing factors to this problem is self-reliance [6] and competitiveness [25]. Although these can be also considered as positive qualities, yet being an individualist until becoming distance from and having low concern of in-group is not a desired outcome for our undergraduates. Moreover, [22] reported that students' interaction with faculty and peers play a positive influence in improving one's retention in engineering school. Therefore, our undergraduates should make full use of this learning phase to foster the value of being helpful and the ability to work with others. The ability to collaborate with others is the most needed skill in today's realm. Hence, stakeholders at the university need to think of the interventions needed to enhance these skills. For example, university can create a helpful environment in the campus by enhancing undergraduates to be aware of their own behaviour and how it impacts on others. Also, helpful environment can be created by demonstrating that the undergraduates value diversity of contribution, reflecting the values for working together.

On the other hand, undergraduates were easy to agree with Item 1 (*I lead a purposeful and meaningful life*). That is, the undergraduates have had a clear goal in themselves while in university. In addition, they also understand the meaning of their lives as an undergraduate. Having clear goal contributes to higher learning motivation to achieve academic success. While understanding the meaning of life contribute to the optimal use of their life span as an undergraduate to not only mastering the content knowledge, but also to sharpen the soft skills as a valuable added value for their career prospect. This is a positive finding because at the tertiary level, undergraduates need to have established their purpose of life. If the students are still looking for their purpose in life, it will certainly cause challenges, especially to adapt to the courses taken. What might be improved is to help students by providing a good environment for achieving student goals and ambitions.

In conclusion, through the analysis of Rasch model, this study has helped identify areas in well-being that needed improvement. And more importantly, the information can be useful for universities to understand the degree to which their students are having meaningful goal with a sense of purpose in life, establishing supportive and rewarding relationships with others, having feelings of competence, as well as continue to grow and develop optimistically. After all, higher education nowadays is more than a transmission of facts; it is also about helping the individual to reach his maximum potential, both personally and professionally [33].

Table 3: PCA of residuals

			Table of standardized residual variance (in eigenvalue units)	
			Empirical	Modelled
Total variance in observations	=	25.8	100.0%	100.0%
Variance explained by measures	=	18.8	72.9%	72.2%
Unexplained variance (total)	=	7.0	27.1%	27.8%
Unexplained variance explained by 1st factor	=	2.0	7.7%	

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