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Employer Perceptions of Student Ability during Industrial Training as assessed by the Rasch Model

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Abstract

This paper presents the Rasch Measurement Model to determine employer perceptions of student ability during industrial training. A questionnaire survey was completed by 280 students from four departments (JKAS, JKMB, JKKP, and JKEES) in the Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM). The survey consists of 20 questions designed by the faculty that described attributes based on the Program Outcomes (POs) that need to be answered by the employers at the end of an industrial training session. Employers were required to answer the question using a Likert scale of 1 to 5 (1 = Not Satisfactory, 5 = Most Satisfactory). Overall, most of the employers were satisfied with the students’ ability to interact (Item Q12) because they gave good marks to most of the students, but most of them were dissatisfied with the students’ leadership ability (Item Q4). The performance of the engineering students in the industrial training program was better than the expected performance; only 4 students were located below the Mean item (poor students), and the rest of the students (N = 276) were above the Mean item (top students). This result proved that the Rasch Measurement Model can precisely describe the performance of each student during the training program, allowing the students’ performance for each attribute to be determined. This result can also be used by the faculty to better prepare the students before the industrial training program.

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Keywords: Rasch Model; industrial training; survey; employer

1. Introduction

Currently, most companies would like to hire well-trained graduates with excellent qualifications and excellent skills. In addition to the conventional methods of learning, industrial training programs are also important for providing students with the knowledge and experience needed to work as an engineer. Students can also learn new skills that are sometimes not taught in the university, such as communication skills among peers and technical writing. Having an industrial training program in the university curriculum would definitely benefit

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the students and simultaneously give them an advantage when looking for future jobs, as discussed by Osman et al. (2009).

For students in the Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM), the industrial training course is compulsory for all students before they can graduate from the university. This is also a requirement of the Board of Engineers Malaysia through the Malaysian Engineering Accreditation Council (EAC) on the university program (Omar et al. 2009). Students are only allowed to go for training if they have completed at least six full-time academic semesters. The training was carried out at various companies throughout Malaysia, from the government to the private sector, for twelve weeks. By the end of the session, employers will have to evaluate the skills obtained by the student based on their performance during the industrial training. According to Omar et al. (2009), this evaluation can be used as a tool in measuring student ability for specific attributes from the employers’ point of view.

In this study, the students’ performance during the industrial training program was measured through questionnaires completed by four engineering departments: Civil and Structure Engineering (JKAS), Electrical and Electronic System Engineering (JKEES); Chemical and Process Engineering (JKKP) and Mechanical and Materials Engineering (JKMB). Based on the employer responses, the questionnaire results were then analyzed using the Rasch Measurement Model. According to Abd. Aziz et al. (2008), the Rasch Model is different from other conventional methods because in the Rasch Model, a more reliable and repeatable measurement instrument is produced rather than establishing a ‘best fit line’. As stated in Saidfudin et al. (2010), the Rasch Measurement Model is an alternative measurement method that focuses on constructing a measurement instrument rather than correcting the data to fit the measurement model with errors. From the Rasch Model, the results from the employer responses were converted to a logit scale to obtain unidimensionality on a linear interval scale for better precision in measuring the students’ performance for each attribute. The output obtained from this analysis can be used to determine the questionnaire’s construct validity and identify unexpected patterns in the items and in student performance.

2. Methodology

A set of question containing 20 attributes, shown in Table 1, was distributed to the employer and needed to be answered at the end of the industrial training session. The attributes were designed based on the program outcomes, as outlined by the faculty, as in Omar et al. (2009). The evaluation for each question was carried out using a Likert Scale of 1 to 5 (1=Not Satisfactory, 5=Most Satisfactory) for each attribute. A total of 280 students in the third year program from four departments were involved in this study: JKAS = 62 students (S001 to S062), JKEES = 59 students (S063 to S121), JKKP = 50 students (S122 to S171) and JKMB = 109 students (S172 to S280).

Table 1 Attributes Measured During Training

| Question No. | Attributes                                      | Question No. | Attributes                          |
|--------------|------------------------------------------------|--------------|------------------------------------|
| Q1           | Adequate background knowledge                   | Q11          | Ability to extract information from various sources |
| Q2           | Ability to apply knowledge                       | Q12          | Ability to interact                 |
| Q3           | Ability to function as a team player             | Q13          | Listening skills                   |
| Q4           | Ability to function as a leader                  | Q14          | Negotiation skills                 |
| Q5           | Ability to carry out instructions                | Q15          | Multicultural and multiracial awareness |
| Q6           | Possess good work ethics and be professional     | Q16          | Nonverbal Skill                    |
| Q7           | Social, cultural, humanity responsibility       | Q17          | Ability to express ideas (verbal)   |
| Q8           | Awareness on related global and environmental issues | Q18       | Ability to express ideas (written)  |
| Q9           | Disciplined and motivated                        | Q19          | Comprehension                      |
| Q10          | Recognize the need for lifelong learning         | Q20          | Punctual and Independent           |
Each question sheet containing responses from an employer was evaluated and tabulated in Excel*prn format for further analysis in the Rasch software Winstep. The raw scores were transformed to logit values, and the outputs obtained from the analysis were analyzed and are discussed in this paper.

3. Discussion and Findings

Figure 1 shows the Person-Item Distribution Map (PIDM) from the analysis of the Rasch Measurement Model in Winsteps. On the right side of the PIDM, it shows the ‘Person’ spread, which refers to the engineering students, whereas the left side of the PIDM shows the ‘Item’ spread, which refers to the 20 attributes evaluated by the employers. There are 280 persons and 20 items measured in this analysis in which person and item are plotted on the same logit scale. Compared with traditional histogram tabulation, the PIDM allows the person and the item to be mapped together and give a better view of the exact performance of all students during the industrial training program (Abd. Aziz et al. 2008).

TABLE 16.3 INTERNSHIP (EMPLOYER) ZOU032W5.TXT Jul 12 2:12 2011

| ITEMS - MAP - PERSONS | PERSON MAX = 10.17 | PERSON MEAN = -4.43 |
|-----------------------|--------------------|---------------------|
| 9                     | S013 S041 S057 S072 S098 S109 S115 S132 S146 S147 | S169 S175 S182 S187 S218 S229 S240 S266 S276 |
| 8                     | S095 S116 S162 S188 S268 | S206 S209 S210 S224 S231 S271 S280 |
| 7                     | S058 S064 S137 S190 S193 S207 S226 S234 | S059 S073 S083 S135 S140 S179 S274 S275 |
| 6                     | S038 S110 S120 S130 S158 S177 S187 S228 S235 S251 | S050 S070 S087 S092 S099 S130 S157 S192 S196 S213 |
| 5                     | S216 S218 S259 S262 S263 | S202 S047 S055 S088 S119 S159 S202 S206 S246 |
| 4                     | S030 S062 S114 S121 S139 S141 S148 S153 S172 S174 | S178 S201 S203 S215 S222 S224 S237 S242 S245 S252 |
| 3                     | S033 S037 S093 S097 S152 S176 S211 S258 | S178 S194 S203 S210 S211 S212 S213 S214 S225 S231 S234 S237 S238 S242 S245 S252 S254 |
| 2                     | S016 S019 S025 S027 S041 S045 S057 S060 S062 S101 | S100 S111 S123 S126 S129 S131 S139 S136 S149 S161 |
| 1                     | S014 S047 S122 S168 S195 S198 S232 S240 | S002 S004 S007 S011 S042 S049 S054 S112 S127 S128 |
| 0                     | S024 S044 S056 S085 S167 S184 S217 S250 S260 | S130 S133 S155 S186 S194 S206 S230 S239 |

Figure 1. Person-Item Distribution Map (PIDM)

Overall, the performance of the engineering students in the industrial training program is above the expected performance; the Person mean value, \( \bar{\text{Mean}}_{\text{person}} \), is 4.43, which is higher than the threshold value, \( \bar{\text{Mean}}_{\text{item}} = 0 \) (Osman et al. 2012). Only 4 students are located below the \( \bar{\text{Mean}}_{\text{item}} \), while the rest of the students (\( N = 276 \)) are above the \( \bar{\text{Mean}}_{\text{item}} \).
According to Figure 1, the easiest item would be Q12, which addresses the ability to interact, while the most difficult item is Q4, which addresses the ability to function as a leader. The figure also shows that if the location of an item in the PIDM is higher than the Mean<sub>item</sub>, the item is considered more difficult compared with the item at the bottom of the Mean<sub>item</sub>. This is why the Mean<sub>item</sub> is set to zero and acts as the threshold value on the logit scale (Osman et al. 2012). Even so, more than half of the students (N = 229) are located above the mean for Q4, which indicate that the performance of these students is excellent. The ability of these students exceeds the difficulty level of the skills measured. Most of the employers were satisfied with the ability possessed by these students and gave them good mark. However, there was one student (S243) located below mean on the easiest item, Q12.

As stated in Osman et al. (2012), the location of the separation between the item and the person shows the ability of the students for each attribute. If the separation is large, the ability of the student to obtain a high mark on each item is high. For example, the distances between the top students, i.e., S012, S053, S067, S072, S098……S276 (marked with the red box) and the easiest item, Q4, are large, which indicate that employers gave the highest mark to these students for the respective item. The person and item distribution in the PIDM is not well spread because there is a blank area at the top of the item section. This blank area needs to be corrected so that the item’s difficulty and a person’s ability are correlated.

The summary statistics for the person and item are shown in Figure 2 below. From the figure, the value of the Cronbach-α is 0.96, with high percentage of valid responses of 99.7%. The value is quite high and above the required level of 0.6 for a 95% confidence interval: p=0.05 (Abd. Aziz et al. 2008). The Person Reliability and Item Reliability values are also excellent, 0.93 and 0.98, respectively. The person separation, G, is good (3.68), which means that the student performance level can be separated into 3 different levels: excellent, good and poor students. The item separation is also large, 6.55, and according to Saidfudin et al. (2010), the value shows a very good differentiation for item difficulty in separating the students into different difficulty levels.

Before proceeding to the person-item map analysis, it is vital to determine whether the questionnaire used as the instrument of measurement is measuring what it is supposed to be measuring. Thus, the construct validity of the questionnaires can be determined based on an Item Measure analysis, as shown in Figure 3. The Item Measure lists the detailed measurement logit for each item that can be used to identify any misfit data by
checking three control parameters: the Point Measure Correlation (PMC), Outfit Mean Square (MNSQ) and z-standard value, ZSTD. The item is considered acceptable and infit if the Point Measure, \( x \), for that item is within the range \( 0.4 < x < 0.85 \). The same is true for the Outfit Mean Square (MNSQ), \( y \) - and z-standard value (ZSTD), \( z \), in which the item measure must be within the range of \( 0.5 < y < 1.5 \) and \( -2 < z < 2 \), respectively. The item is misfit when all three control parameters are not in the range, as mentioned earlier. Because only the z-standard value (ZSTD) for item Q14 is out of range, this item cannot be considered misfit. The item measures for the other items are also within the range for all three control parameters. Therefore, all the items are acceptable and need no review (Osman et al. 2011).

| Table 3.1 Internship (Employer) | ZOO032W.SXT Jul 12 2:12 2012 |
|----------------------------------|--------------------------------|
| Input: 280 Persons 20 Items | MEASURE: 280 Persons 20 Items 5 CATS 3.68.2 |
| Person: REAL SEP.: 3.68 REL.: .93 ... | Item: REAL SEP.: 6.55 REL.: .98 |

**Table 3.1 Internship (Employer)**

| ENTRY NUMBER | TOTAL SCORE | COUNT | MEASURE | MODEL S.E. | INFIT MNSQ ZSTD | OUTFIT MNSQ ZSTD | PT-MEASURE CORR. EXP. | EXACT MATCH OBSW EXPW | DISPLACE Item |
|--------------|-------------|-------|---------|-----------|----------------|------------------|----------------------|---------------------|---------------|
| 4            | 1053        | 278   | 1.93    | 0.13      | 1.09 1.14 | 1.5 | 0.72 | 0.76 | 68.5 | 69.2 | 0.00 Q4 |
| 1            | 1092        | 280   | 1.43    | 0.13      | 1.04 1.06 | 0.7 | 0.66 | 0.74 | 67.7 | 69.8 | 0.00 Q1 |
| 20           | 1097        | 275   | 1.06    | 0.13      | 1.00 1.07 | 0.7 | 0.73 | 0.74 | 72.3 | 70.0 | 0.00 Q20 |
| 8            | 1128        | 280   | 0.84    | 0.13      | 1.15 1.16 | 1.6 | 0.72 | 0.73 | 65.1 | 70.6 | 0.00 Q8 |
| 9            | 1133        | 280   | 0.76    | 0.13      | 1.01 1.00 | 0.0 | 0.72 | 0.73 | 72.5 | 70.8 | 0.00 Q9 |
| 10           | 1149        | 280   | 0.49    | 0.13      | 1.12 1.08 | 0.9 | 0.72 | 0.73 | 69.1 | 71.6 | 0.00 Q10 |
| 11           | 1154        | 280   | 0.40    | 0.13      | 1.01 1.02 | 0.2 | 0.70 | 0.72 | 70.6 | 71.8 | 0.00 Q11 |
| 7            | 1152        | 279   | 0.36    | 0.13      | 0.92 1.11 | 0.1 | 0.74 | 0.72 | 73.5 | 72.0 | 0.00 Q7 |
| 2            | 1175        | 280   | 0.04    | 0.13      | 0.93 1.08 | 1.1 | 0.73 | 0.72 | 74.0 | 72.6 | 0.00 Q2 |
| 19           | 1168        | 277   | -0.04   | 0.13      | 1.19 2.12 | 1.0 | 0.66 | 0.71 | 69.5 | 72.9 | 0.00 Q19 |
| 5            | 1189        | 280   | -0.22   | 0.13      | 1.16 1.09 | 0.8 | 0.69 | 0.71 | 68.8 | 73.1 | 0.00 Q5 |
| 6            | 1187        | 279   | -0.24   | 0.14      | 1.04 1.02 | 0.2 | 0.69 | 0.71 | 72.0 | 73.2 | 0.00 Q6 |
| 15           | 1195        | 280   | -0.33   | 0.14      | 0.91 1.0 | 0.86 | 0.73 | 0.71 | 75.8 | 73.3 | 0.00 Q15 |
| 3            | 1201        | 279   | -0.44   | 0.14      | 0.88 1.14 | 0.0 | 0.81 | 0.71 | 75.0 | 75.7 | 0.00 Q3 |
| 17           | 1202        | 279   | -0.52   | 0.14      | 1.00 1.0 | 0.0 | 0.95 | 0.74 | 70.7 | 73.9 | 0.00 Q17 |
| 18           | 1201        | 278   | -0.58   | 0.14      | 0.83 1.19 | 0.86 | 0.73 | 0.71 | 70.7 | 73.9 | 0.00 Q18 |
| 14           | 1221        | 280   | -0.81   | 0.14      | 0.75 3.0 | 0.68 | 2.6 | 0.73 | 69.6 | 74.5 | -0.01 Q14 |
| 16           | 1231        | 279   | -1.08   | 0.14      | 0.92 1.05 | 0.6 | 0.71 | 0.68 | 75.0 | 75.0 | -0.01 Q16 |
| 13           | 1239        | 280   | -1.17   | 0.14      | 0.90 1.01 | 0.1 | 0.81 | 0.70 | 68.6 | 75.5 | -0.01 Q13 |
| 12           | 1270        | 279   | -1.90   | 0.15      | 0.97 -3.8 | 1.86 | -2.6 | 0.67 | 64.0 | 80.6 | 76.6 | -0.01 Q12 |

**Figure 3 Item Measure**

Figure 4 shows the total measure given by the employers for each student. Although the Rasch analysis was carried out for all 280 students, only those being discussed are presented and shown in the figure. The students are sorted randomly from the excellent (highest score) to the poor students (lowest score). There are 19 students that received a high score from the employers, and these students are located at the top of the table. The employers were very satisfied with the performance of these students and gave them high marks. In contrast, the lowest mark was given to student S243.

There are also 22 students that have been identified as misfit according to the 3 control parameters mentioned in the Item Measure. For example, student S035 is one of the misfit students because all 3 control parameters are out of range and marked with a blue box in the table. By referring to the Scalogram pattern shown in Table 5, the pattern of respond for this student does not match the ideal model (Osman et al. 2012). The ideal pattern of respond involves the highest score for the easy item and the lowest score for the difficult item on the right. However, this student did not receive the highest mark for an easy item but received a good score for the difficult item, which means that he/she did not perform well on an easy task but did perform well on a difficult task.
### Figure 4 Person Measure

| ENTRY | TOTAL | MODEL | INIT | OUTFIT | PT-MEASURE | EXACT MATCH | NUMBER | SCORE | COUNT | MEASURE S.E. | MNSQ ZSTD | MNSQ ZSTD | CORR. EXP. | EXP. | Person |
|-------|-------|-------|------|--------|------------|-------------|--------|-------|-------|-------------|-----------|-----------|------------|-----|--------|
| 12    | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S012 |
| 67    | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S067 |
| 72    | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S072 |
| 98    | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S098 |
| 111   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S111 |
| 146   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S146 |
| 147   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S147 |
| 218   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S218 |
| 229   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S229 |
| 266   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S266 |
| 276   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S276 |
| 276   | 100   | 20    | 10.17| 1.85   | MAXIMUM MEASURE...00 | .00 | 100.0 | 100.0 | S276 |
| 53    | 99    | 20    | 8.90 | 1.05   | .91 | .37 | -.1 | .36 | .19 | .95 | .95 | .95 | .95 | S053 |
| 9     | 89    | 20    | 5.42 | .47    | .72 | 1.3 | -.68 | -.3 | 1.6 | .60 | .70 | .70 | .70 | S009 |
| 35    | 89    | 20    | 5.42 | .47    | 1.64 | 2.4 | 1.82 | 2.7 | -.41 | .40 | .50 | .50 | .50 | S035 |
| 46    | 89    | 20    | 5.42 | .47    | 2.24 | 4.1 | 2.54 | 4.3 | -.54 | .40 | .60 | .60 | .60 | S046 |
| 227   | 56    | 20    | -1.39| .39    | 1.40 | 1.1 | 1.53 | 1.3 | -.32 | .46 | .45 | .45 | .45 | S227 |
| 243   | 45    | 20    | -2.82| .34    | 1.48 | 1.6 | 1.50 | 1.6 | -.38 | .52 | .45 | .45 | .45 | S243 |
| MEAN  | 83.7  | 19.9  | 4.43 | .56    | .99 | 1.1 | .97 | -.2 | .1 | .3 | .2 | .2 | .2 | .2 |
| S.D.  | 9.8   | 4     | 2.39 | .28    | .52 | 1.5 | .57 | 1.5 | -.5 | .1 | .6 | .6 | .6 | .6 |

### Figure 5 Scalogram
4. Conclusion

In conclusion, the overall performance of the student shows that most of the employers were satisfied with the skills that the students have because they gave good marks to most of them. Most of the employers are satisfied with the students’ ability to interact but most of them were dissatisfied with students’ leadership ability, as shown in the PIDM. Therefore, a new approach or task must be introduced to improve this ability. From the Rasch analysis, student achievement can be plotted against the questionnaire, and the suitability of the questionnaire can be identified simultaneously with the students’ ability. These results can also be used as a guideline for lecturers when planning suitable methods to prepare students before they undergo their industrial training.

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