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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, JKPP, 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

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 $\text{Mean}_{\text{item}}$, the item is considered more difficult compared with the item at the bottom of the $\text{Mean}_{\text{item}}$. This is why the $\text{Mean}_{\text{item}}$ 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.

TABLE 3.1 INTERNSHIP (EMPLOYER)				ZOU004WS.TXT Jul 13 2:37 2012				
INPUT: 280 Persons 20 Items MEASURED: 280 Persons 20 Items 5 CATS				3.68.2				
SUMMARY OF 269 MEASURED (NON-EXTREME) Persons								
	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD
MEAN	83.0	19.9	4.19	.51	.99	-.1	.97	-.2
S.D.	9.4	.4	2.13	.11	.52	1.5	.57	1.5
MAX.	99.0	20.0	8.90	1.05	3.71	4.9	3.67	4.9
MIN.	45.0	15.0	-2.82	.34	.17	-3.3	.14	-3.4
REAL RMSE	.56	ADJ. SD	2.06	SEPARATION	3.68	Person RELIABILITY		.93
MODEL RMSE	.52	ADJ. SD	2.07	SEPARATION	3.97	Person RELIABILITY		.94
S.E. OF Person MEAN = .13								
MAXIMUM EXTREME SCORE:				11 Persons				
VALID RESPONSES:				99.7%				
Person RAW SCORE-TO-MEASURE CORRELATION = .97 (approximate due to missing data)								
CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .96 (approximate due to missing data)								
SUMMARY OF 20 MEASURED (NON-EXTREME) Items								
	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD
MEAN	1171.8	279.1	.00	.13	1.00	.0	.97	-.2
S.D.	52.2	1.3	.91	.01	.11	1.3	.13	1.1
MAX.	1270.0	280.0	1.93	.15	1.19	2.0	1.16	1.6
MIN.	1053.0	275.0	-1.90	.13	.75	-3.0	.68	-2.6
REAL RMSE	.14	ADJ. SD	.90	SEPARATION	6.55	Item RELIABILITY		.98
MODEL RMSE	.13	ADJ. SD	.90	SEPARATION	6.69	Item RELIABILITY		.98
S.E. OF Item MEAN = .21								
UMEAN=.000 USCALE=1.000								
Item RAW SCORE-TO-MEASURE CORRELATION = -.99 (approximate due to missing data)								
5363 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 6650.43 with 5072 d.f. p=.0000								

Figure 2. Summary Statistics

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 13.1 INTERNSHIP (EMPLOYER)														
ZOU032WS.TXT Jul 12 2:12 2012														
INPUT: 280 Persons 20 Items MEASURED: 280 Persons 20 Items 5 CATS 3.68.2														
Person: REAL SEP.: 3.68 REL.: .93 ... Item: REAL SEP.: 6.55 REL.: .98														
Item STATISTICS: MEASURE ORDER														
ENTRY NUMBER	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFI T	OUTFI T	PT-MEASU RE	EXACT MATCH	DISPLA CE	Item				
4	1053	278	1.93	.13	1.09	1.1	1.14	1.5	.72	.76	68.5	69.2	.00	Q4
1	1092	280	1.43	.13	1.04	.4	1.06	.7	.66	.74	67.7	69.8	.00	Q1
20	1097	275	1.06	.13	1.00	.0	1.07	.7	.73	.74	72.3	70.0	.00	Q20
8	1128	280	.84	.13	1.15	1.7	1.16	1.6	.72	.73	65.1	70.6	.00	Q8
9	1133	280	.76	.13	1.01	.1	1.00	.0	.72	.73	72.5	70.8	.00	Q9
10	1149	280	.49	.13	1.12	1.4	1.08	.9	.72	.73	69.1	71.6	.00	Q10
11	1154	280	.40	.13	1.01	.1	1.02	.2	.70	.72	70.6	71.8	.00	Q11
7	1152	279	.36	.13	.92	-.9	.88	-1.1	.74	.72	73.5	72.0	.00	Q7
2	1175	280	.04	.13	.93	-.8	.91	-.8	.73	.72	74.0	72.6	.00	Q2
19	1168	277	-.04	.13	1.19	2.0	1.12	1.0	.66	.71	69.5	72.9	.00	Q19
5	1189	280	-.22	.13	1.16	1.8	1.09	.8	.69	.71	68.8	73.1	.00	Q5
6	1187	279	-.24	.14	1.04	.5	1.02	.2	.69	.71	72.0	73.2	.00	Q6
15	1195	280	-.33	.14	.91	-1.0	.86	-1.2	.73	.71	75.8	73.3	.00	Q15
3	1201	280	-.44	.14	.88	-1.4	.81	-1.7	.75	.70	75.5	73.6	.00	Q3
17	1202	279	-.52	.14	1.00	.0	.95	-.4	.74	.70	75.7	73.9	.00	Q17
18	1201	278	-.58	.14	.83	-1.9	.86	-1.1	.73	.70	78.7	74.1	-.01	Q18
14	1221	280	-.81	.14	.75	-3.0	.68	-2.6	.73	.69	79.6	74.5	-.01	Q14
16	1231	279	-1.08	.14	1.05	.6	.96	-.2	.71	.68	75.0	75.0	-.01	Q16
13	1239	280	-1.17	.14	.90	-1.1	.81	-1.2	.70	.68	75.5	75.1	-.01	Q13
12	1270	279	-1.90	.15	.97	-.3	.86	-.6	.67	.64	80.6	76.6	-.01	Q12
MEAN	1171.9	279.1	.00	.13	1.00	.0	.97	-.2			73.0	72.7		
S.D.	52.2	1.3	.91	.01	.11	1.3	.13	1.1			4.1	1.9		

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.

TABLE 17.1 INTERNSHIP (EMPLOYER)											
ZOU032WS.TXT Jul 12 2:12 2012											
INPUT: 280 Persons 20 Items MEASURED: 280 Persons 20 Items 5 CATS 3.68.2											
Person: REAL SEP.: 3.68 REL.: .93 ... Item: REAL SEP.: 6.55 REL.: .98											
Person STATISTICS: MEASURE ORDER											
ENTRY	TOTAL	MODEL	INFIT	OUTFIT	PT-MEASURE	EXACT MATCH					
NUMBER	SCORE	COUNT	MEASURE	S.E.	MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.	OB5% EXP%
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
53	99	20	8.90	1.05	.91	.2	.37	-.1	.36	.19	95.0 95.0
. . . (S109 - S159)											
9	89	20	5.42	.47	.72	-1.3	.68	-1.3	.60	.40	75.0 65.1
35	89	20	5.42	.47	1.64	2.4	1.82	2.7	-.41	.40	35.0 65.1
46	89	20	5.42	.47	2.24	4.1	2.54	4.3	.54	.40	50.0 65.1
. . . (S076 - S163)											
227	56	20	-1.39	.39	1.40	1.1	1.53	1.3	.32	.46	45.0 67.0
243	45	20	-2.82	.34	1.48	1.6	1.50	1.6	.38	.52	45.0 51.0
MEAN	83.7	19.9	4.43	.56	.99	-.1	.97	-.2			73.0 72.7
S.D.	9.8	.4	2.39	.28	.52	1.5	.57	1.5			15.2 6.8

Figure 4 Person Measure

TABLE 22.1 INTERNSHIP (EMPLOYER)											
ZOU032WS.TXT Jul 12 2:12 2012											
INPUT: 280 Persons 20 Items MEASURED: 280 Persons 20 Items 5 CATS 3.68.2											

GUTTMAN SCALOGRAM OF RESPONSES:											
Person	Item										
	111111 1 1 11 2										
	23648735659271098014										

12	+55555555555555555555555555555555 S012										
67	+55555555555555555555555555555555 S067										
72	+55555555555555555555555555555555 S072										
98	+55555555555555555555555555555555 S098										
111	+55555555555555555555555555555555 S111										
146	+55555555555555555555555555555555 S146										
147	+55555555555555555555555555555555 S147										
218	+55555555555555555555555555555555 S218										
229	+55555555555555555555555555555555 S229										
266	+55555555555555555555555555555555 S266										
276	+55555555555555555555555555555555 S276										
53	+55555555555555555555555555555555 S053										
	. . . (S109 - S159)										
9	+55555555555555555555555555555555 S009										
35	+44445555555555555555555555555555 S035										
46	+55555555555555555555555555555555 S046										
	(S076 - S163)										
227	+442423333223322332233233 S227										
243	+223333333124322111231 S243										

	111111 1 1 11 2										
	23648735659271098014										

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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