

Survey and assessment of web-based platform for checking settlement-ability of students of engineering and natural sciences

¹Vijay Kalbande, ²Shitalkumar Rawandale, ³Arvind Bodhe, ⁴Naresh Tawale, ⁵Chandrabhas Handa

¹Nagpur Institute of Technology, Nagpur, Maharashtra, India, drvijaykalbande@gmail.com

²Pimpri Chinchwad College of Engineering, Pune, Maharashtra, India

³GH Rasoni University, Saikheda, Madhya Pradesh, India

⁴Nagpur Institute of Technology, Nagpur, Maharashtra, India

⁵KDK College of Engineering, Nagpur, Maharashtra, India

Abstract

Nowadays engineering students are losing their campus placement opportunities provided by the institutes due to non-awareness of the market requirements. In this research, the authors try to develop an online platform for checking placement capability as well as level of skills required for the industry of engineering students in campus placement for IT Sector. Data was collected from the Final year engineering students of Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur. Primary data of students 'skills performance was collected by using pen and paper test and Secondary data i.e., placement record was collected directly from the respective institutes. The various models developed and finalized one based on research constraints and R² value. Online platform was developed for Binary Logistic Regression Model to predict placement capability of engineering students. This online platform will support institutes as well as students to understand the level of preparation of students for upcoming campus placement season and make systematic plan to enhance required skills up to optimum level.

Keywords: Campus placement, engineering students, skills, online platform, IT sector.

1. INTRODUCTION

In today's scenario, campus placement activity in engineering institutes plays a crucial role. Campus placement has become an important criterion used by leading ranking agencies around the world. The parents prefer institutes who provide more job opportunities through their campus placement drive. Institutes organize pool campus placement drive for Information Technology Sector where bulk recruiters are multinational companies. On the other hand, many undergraduate students are not able to get the job through the campus recruitment process. Current technological and economic changes created a challenging framework for the students. Multinational

companies are expecting many competencies from fresh engineering graduates at entry level. Due to global clients in IT Sector, the company hires effective manpower. Increasing number of technical institutes and reducing demand from company suddenly increases their expectations from the graduates [1].

These days, soft skills are essential for any individual to communicate well and to get succeed. As per previous study, most of the graduates are found good in academics but weak in communication skill and that puts a hurdle in their career opportunities [2]. Industries are depended on universities/institutes to fulfil their manpower requirements of innovative thinking,

creativeness, quick learning and communicate effectively. IT companies are recruiting students based on analytical, technical knowledge and soft skills irrespective of the engineering branch. They are giving more priority to the candidates with skill of teamwork and interpersonal relationships [3]. MNCs in India are looking for well-trained employable individuals [4]. As per survey of Aspiring Mind and NASSCOM, employability of undergraduate students is very low, and employers are unsatisfied from the recruited fresh candidates [5] [6]. To overcome this mismatch to some extent, the research work is carried out and develop mathematical tool to check placement capability and level of skills of engineering students in IT Sector.

2. Methodology

In this research, the data of stakeholders involved in campus placement activity was used to validate the skill sets required at entry level in IT sector [7]. Convenience sampling method was used to collect the primary data through questionnaires. The secondary data of placement record was collected from Training & Placement Department of selected institutes. After data smoothening by the application of filtration techniques, 362 sample datasets of engineering students were used as primary data and placement record of above students along with number of attempts required for getting offer letter were used as secondary data for this research work. The step-by-step research process was used to complete the research work as shown in figure 1.

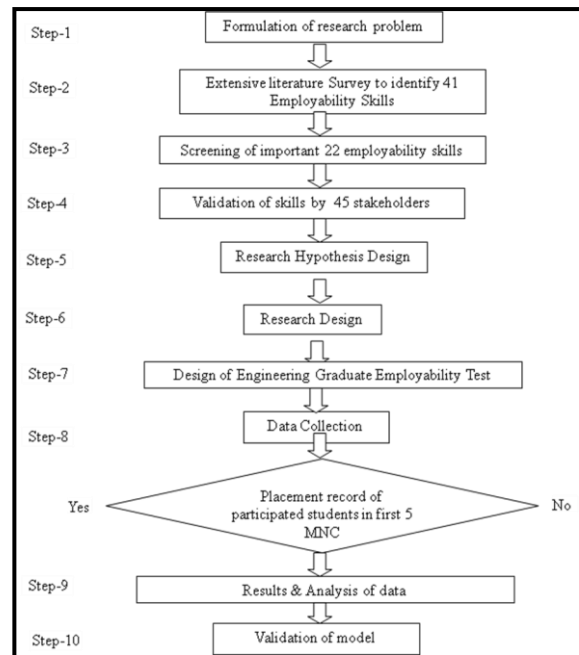


Figure 1. Research work step by step process

3. Data analysis

The data was collected from final year engineering students at engineering institutes affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur by using the questionnaires and their placement record to measure performance of engineering students on skills. Based on Research work assumptions, limitations, and filtration, 362 samples of engineering students were finalized for the analysis in the research study as shown in table 1.

Assumptions in the research work

- There is no fluctuation in employment scenario in the country.
- Students having percentages above 60 % in SSC, HSC and B.E.
- Only first five multinational IT Sector bulk recruiter companies like TCS, Accenture, Wipro, Tech Mahindra, and Infosys considered. No categorization based on salary (Salary Range: 2.5 to 3.5 lakhs per annum in Indian Rupees)
- Students placed in above first five companies considered as placed students-coded as 1 whereas participated but not

selected in above five companies are considered as unplaced students- coded as 0.

- Samples collected by conducting pen & paper test just one month before the actual placement season start for the fresh batch.

Table 1. *Dataset of 362 samples with Yes/No output*

Sample No.	Aptitude (X ₁ - 25)	Communication (X ₂ - 25)	Technical (X ₃ - 25)	Personality (X ₄ - 25)	Yes/No Output (Y)
1	21	10	15	21	1
2	21	11	14	20	1
3	20	14	17	16	1
-	-	-	-	-	-
147	18	14	12	12	1
148	17	8	12	14	1
-	-	-	-	-	-
251	17	9	7	9	1
252	12	8	12	10	1
253	13	6	11	12	1
-	-	-	-	-	-
360	6.00	9	12.00	15	0
361	13.00	8	6.00	15	0
362	13.00	9	6.00	13	0

3.1. Adequacy and sphericity

It is necessary to check adequacy of collected dataset before developing a model. The adequacy and sphericity of 362 sample dataset

of Yes/No output was checked by using Kaiser Meyer Olkin (KMO) method [8] [9]. The test was conducted by using SPSS version 20 as shown in table 2.

Table 2. *Kaiser Meyer Olkin (KMO) test*

Adequacy and Sphericity	Yes/No	Output-	Recommended
Adequacy.	.712		Kaiser, (1974) Acceptable >0.5
Approx. Chi-Square	411.091		Mediocre - 0.5 to 0.7 and Good - 0.7 to 0.8
Degree of freedom	10		
Significance	.000		
Adequacy of dataset	Good		

From above table 2, the adequacy value for Yes/No Output dataset is found good. It is also confirmed by Bartlett's Test of Sphericity, which tested Chi Square test significant $P=0.000$ ($P<0.05$). Hence, the collected dataset of Yes/No output is used to develop the mathematical model.

3.2. Formulation of models

A mathematical relation has been developed to check placement capability based on skills set of technical students. Skill set i.e., Aptitude (X₁), Communication (X₂), Technical (X₃) and Personality skill (X₄) considered as independent variables and Placement capability (Y) considered as dependent variable. The correlation of variables can be express mathematically as

$$\text{Placement Capability (Y)} = f(X_1, X_2, X_3, X_4)$$

As per the trend, bulk recruiter IT companies visited in early slots, minimum within first 5 slots. T & P officer also tries to place maximum students within first 5 slots. Therefore, the students placed in first 5 opportunities are considered as placed and other considered as unplaced. In this research, the two models have been developed for Yes/No output i.e., Linear Multiple Regression Model and Binary Logistic Regression Model.

3.2.1. Linear multiple regression model. The students who received offer within 5 MNCs are recorded as Yes (1) and other recorded as No (0). The dataset 362 samples with Yes/No output were used to design Linear multiple regression model by using SPSS version 20. The result of Linear multiple regression model is as shown in table 3 and table 4.

Table 3. *Summary for Linear Multiple Regression Model*

Mode	R	R	Adjusted R	Std. Error
------	---	---	------------	------------

1	Square	Square	of the Estimate
1	.742	.551	.546
			.33521

Table 4. *Coefficient for skills with constant K*

Model	Un-standardized B	Std. Error	Standardized Beta	t	Sig.	95.0% Confidence Interval for B	
						Lower Bound	Upper Bound
(Const)	-1.108	.095		-11.656	.000	-1.295	-.921
X_1	.044	.004	.388	10.159	.000	.036	.053
X_2	.029	.007	.166	4.399	.000	.016	.042
X_3	.054	.005	.390	9.866	.000	.043	.065
X_4	.015	.006	.100	2.645	.009	.004	.026

Linear Multiple Regression Model (R² = 0.551)

$$Y = 0.044X_1 + 0.029X_2 + 0.054X_3 + 0.015X_4 - 1.108$$

For X₁>5, X₂>4, X₃>5, X₄>6

3.2.2. Binary logistic regression model. In ordinary regression, the predicted values are greater than one and less than zero for few samples which is theoretically inadmissible. The dependent variable is in Yes/No form i.e 1 for Yes and 0 for No and expected output in probability of placed on unplaced i.e. 1 on 0. In this type of previous research work, Binary logistic regression was used to develop model for correlation and satisfied the requirements of the research work [10]. Placement capability Y with skills X₁, X₂, X₃ and X₄ in BLRM is as shown below.

$$Y = e^{a+bx} / (1 + e^{a+bx})$$

where,

Y is the probability of 1 on 0

e is the base of the natural logarithm

a & b are the constant

3.2.3. Find out cut-off value to get optimum accuracy of model. To find out placement

Table 6. *Summary of Binary logistic regression model*

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	220.633a	.534	.716

From the table 6, Nagelkerke R² value 0.716 indicates a moderately strong relationship between employability skills (X₁, X₂, X₃, X₄) with Placement capability (Y). The coefficient

capability by using binary logistic regression model (BLRM), cut off value is required as input in SPSS Version 20. For each cut off value, the predicted accuracy of placed/unplaced group is obtained by running binary logistic regression model. Predicted accuracy of placed and unplaced group in % was found by varying cut off value from 0.2 to 0.8 as shown in table 5.

Table 5. *Accuracy with cut off value*

Cut off	% Accuracy of	% Accuracy of
0.2	94.5	63.4
0.3	92	72
0.4	90	79.5
0.5	87.6	85.7
0.6	85.1	90.1
0.7	82.6	92.5
0.8	74.6	97.5

From table 5, it was observed that the predicted accuracy for placed and unplaced group was found optimum at cut off value of 0.5. The prediction accuracy of placed group is 87.6 % and unplaced group is 85.7 %. The Overall prediction success rate of the model was 86.7 %. This cut off value 0.5 was used at 95% confidence level to design Binary logistic regression model as shown in table 6.

of input variables in the equation for the model is shown in table 7.

Table 7. Coefficient of skills set and constant K

Skills Set	Coefficients	Wald Coefficient.	Rank	Sig.	95% C.L. for EXP(B)	
					Lower	Upper
X_1	.379	54.733	1	.000	1.321	1.615
X_2	.283	16.842	3	.000	1.159	1.520
X_3	.498	51.290	2	.000	1.436	1.885
X_4	.130	5.371	4	.020	1.020	1.272
B	-14.414	85.122		.000		

Binary Logistic Regression model from above table formulated as

$$\text{Logit } y = 0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414$$

$$Y = e^{(0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414)} / (1 + e^{(0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414)})$$

$$Y = 0 \text{ for } X_1 < 6, X_2 < 5, X_3 < 6, X_4 < 7$$

The above model used to check Placement Capability of technical graduate students based on skill sets required in IT Sector. All employability skills are contributed significantly at significance level 0.05 ($P < 0.05$). The ranking of skills was done based on Walt Coefficient as shown in above table 7. As the ranking of employability skills goes on increasing, its impact on employability decreases. So Aptitude skill (X_1) (Walt Coefficient: 54.73) have maximum impact on employability whereas Personality skill (X_4) (Walt Coefficient: 5.371) have least impact.

3.2.4. Procedure to develop Binary logistic regression model by using SPSS. The following instructions are followed to design Binary logistic regression model by using SPSS Version 20. The model has been developed to establish correlation between skills sets with Placement capability of engineering students in campus placement for IT Sector. The BLRM is developed for sample of 362 engineering students with binary output Yes (1) and No (0) in following steps.

- Upload 362 samples in SPSS sheet and define variables as follows:

Aptitude (X_1), Communication (X_2), Technical (X_3) and Personality Skill (X_4)

Yes/No output as Placement capability (Y)

Click Analyze >>Regression >>Binary Logistic as shown in figure 2

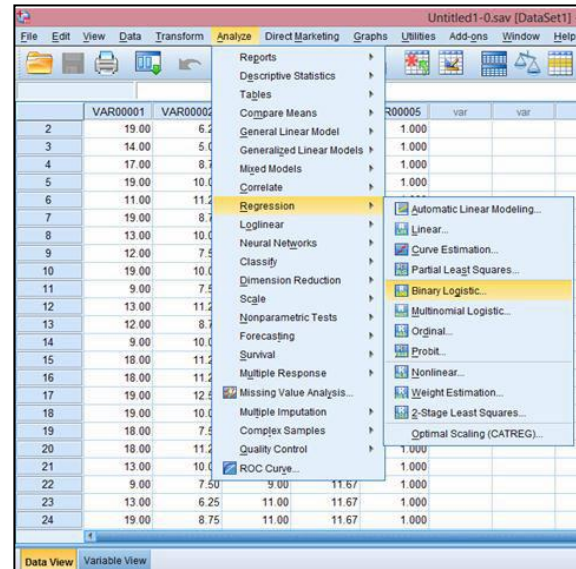


Figure 2. Selection of Binary logistic regression method

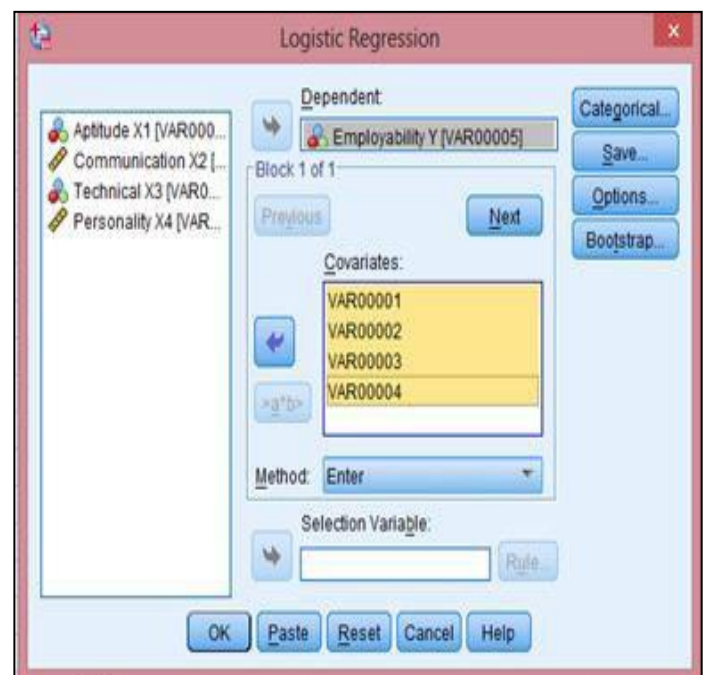


Figure 3. Selection of dependent and covariates (independent) variables

- Enter your predictors (IV's) into the Covariates box as shown in figure 3. These are Aptitude, Communication, Technical and Personality skills. Do not alter the default method of Enter unless you wish to run a Stepwise logistic regression. Likelihood ratio test (chi square difference) which is used to decide which variables add or delete from the model.
- Select various options in Logistic regression like Classification Cut off, Hosmer-Lemeshow goodness of fit test, Confidence level etc., as shown in figure 4.

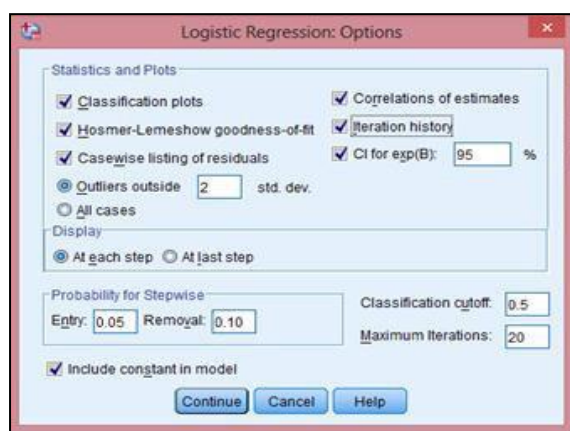


Figure 4. Selection of Logistic regression options

- Click continue to get various tables like Classification table, Variable in the Equation with constant, Correlation matrix, Model summary, Prediction accuracy of the model etc., as shown in figure no. 5.

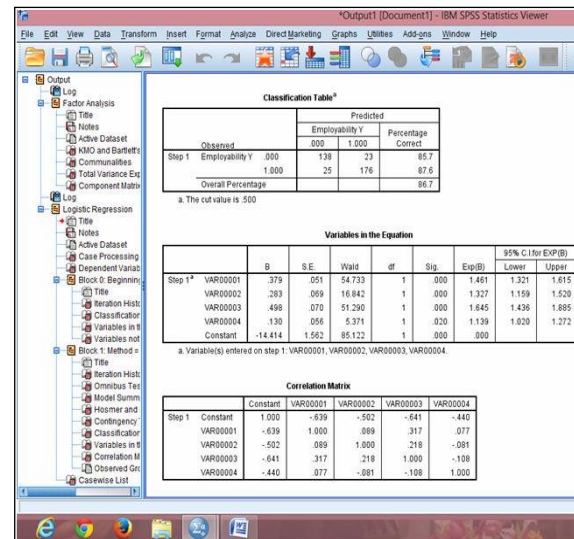


Figure 5. Binary logistic regression model

4. Optimum level of employability skills

In this research work, the opinion of 45 stake holders were collected on 1-10 scale based on importance of employability skills to hire fresh engineering graduates at entry level. The optimum level of each employability skill was found out by using average weightage given by stake holders as shown in table 8. From the student's data set, it is observed that the probability of placement of students are achieved 100% at the values of 22, 16, 19 and 21 in Aptitude, Communication, Technical and Personality skill respectively. Thus, the gap between their skills was identified in selected students based on stakeholders' expectations and students' performance in the skill test.

Table 8. Optimum level of employability skills by using stakeholders' opinion

Employability Skills	Aptitude Skill X_1	Communication Skill X_2	Technical Skill X_3	Personality Skill X_4
Average weightage given by stakeholders	80.7 %	79.5%	77.6%	80.1%
Optimum level of each employability skill (Maximum score = 25)	25*0.807 7 =20.17	25*0.795 =19.87	25*0.776 =19.40	25*0.801 =20.02

The optimum values for skills set (X_1 , X_2 , X_3 & X_4) were found 20.17, 19.87, 19.40 and 20.02 for Aptitude, Communication, Technical and Personality skill respectively.

Placement capability at optimum value by using Binary logistic regression model is given by

$$Y = e^{(0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414)} / (1 + e^{(0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414)})$$

= 1 i.e., 100 % Placement Capability

From above analysis, getting predicted accuracy of placed group 100 % at optimum level of employability skills indicates that the model predicting result accurately and validated the model. The optimum level of skills set i.e., Aptitude, Communication, Technical and Personality skill scores are 80.7% (20.17), 79.5% (19.87), 77.6% (19.40) and 80.1% (20.02) respectively.

5. Sensitivity analysis for Binary logistic regression model

Impact of each employability skill on probability of placement was checked by sensitivity analysis. Table 9 shows the minimum, average and maximum value of employability skills.

Table 9. Average scores for each employability skills

Employability Skills	Minimum Value	Maximum Value	Average Value
Aptitude	5	22	13.5
Communication	4	16	10
Technical	5	19	12
Personality	6	21	13.5

5.1. Effect of Aptitude Skills on Placement Capability

Aptitude employability skill (X_1) varies from minimum to maximum by keeping other skills constant i.e., average value ($X_2=10$, $X_3=12$, $X_4=13.5$) to calculate probability of placement (Y_{x1}) as shown in table 10. A graph between Aptitude skill on X axis and Placement capability on Y axis is shown in figure 6.

Table 10. Impact of Aptitude skill (X_1) on Placement Capability (Y_{x1})

X_1	X_2	X_3	X_4	Y_{x1}	Rate of change
5	10	12	13.5	0.08	0.02
6	10	12	13.5	0.11	0.03
7	10	12	13.5	0.16	0.04
8	10	12	13.5	0.21	0.06
9	10	12	13.5	0.28	0.07
10	10	12	13.5	0.36	0.08
11	10	12	13.5	0.46	0.09
12	10	12	13.5	0.55	0.09
13	10	12	13.5	0.64	0.09
14	10	12	13.5	0.72	0.08
15	10	12	13.5	0.79	0.07
16	10	12	13.5	0.85	0.06
17	10	12	13.5	0.89	0.04
18	10	12	13.5	0.92	0.03
19	10	12	13.5	0.95	0.02
20	10	12	13.5	0.96	0.02

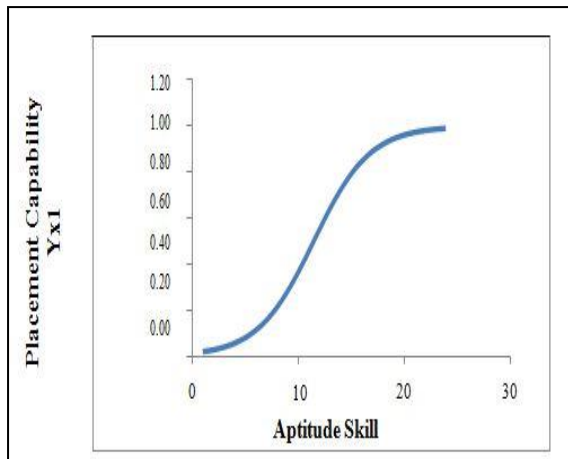


Figure 6. Effect of Aptitude skill (X_1) on Placement Capability (Y_{x1})

From table 10 and figure 6, it is observed that rate of change of predicted Placement capability output (Y_{x1}) is more than rate of change of Aptitude skill (X_1) scores from 5 to 10. Aptitude skill is linearly changed with Placement capability from 11 to 13. Whereas rate of change of probability of placement decreases with increase in Aptitude skill from 14 to 18 and negligible improvement after 19. It means the students need to enhance Aptitude skill level up to 18 along with other skills. Similarly, sensitivity analysis carried out for remaining skills as shown in figure 7.

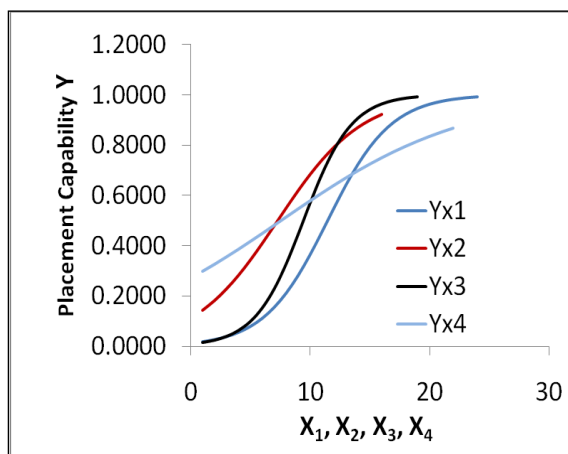


Figure 7. Effect of X_1 , X_2 , X_3 & X_4 on Placement Capability Y

Optimum value of Aptitude, Technical, Communication and Technical Skill based on sensitivity analysis are 18, 16, 16 and 17 respectively. The probability of placement at optimum value by using Binary logistic regression model is 0.9992 i.e., 99.92%. This

suggests the students should possess their employability skills i.e., Aptitude, Technical, Communication and Technical Skill minimum 18, 16, 16 and 17 respectively to achieve 100% Probability of placement in campus placement for IT Sector.

Figure 7 shows that the 100 % probability of placement is can be achieved by focusing not only on any single employability skill but also the students need to focus on all employability skills. Aptitude skill X_1 shows more sensitive followed by technical skill X_3 whereas personality skill X_4 shows less sensitivity on placement capability. Initially, rate of change of placement capability is found more than rate of change of employability skill where as vice-versa at the end. The ranking of the employability skills was done based on sensitivity analysis as shown in Table 11.

Table 11. Ranking of Employability Skills

Employability Skills	Ranking
Aptitude Skill, X_1	1
Technical Skill, X_3	2
Communication Skill, X_2	3
Personality Skill, X_4	4

6. Development of online platform

This research was carried out to check the placement capability of engineering students in campus placement for IT sector and to find their level of skills. Out of two models developed for Yes/No output, only binary logistic regression model (BLRM) predicts placement capability in the range of 0 to 1. The overall prediction accuracy of the model is found 86.7%. In other model, the predicted value of probability of placement is more than 1 or less than 0 in few samples which is theoretical inadmissible. Hence the software is developed based on BLR model to measure placement capability and level of employability skills of engineering students for IT Sector.

Engineering Graduate Employability Test (EGET) software is developed by using the following technologies:

- HTML
- Bootstrap
- Node.js
- JavaScript
- My SQL

User interface is created by using Bootstrap technology. Node.js is used for server-side programming. Data base is created in My SQL. The site is designed by using HTML. The report is displayed by using Javascript in HTML programming.

6.1. Example

Let us assume that a student has scores on Aptitude, Communication, Technical and Personality skills are 8, 10, 15 and 13 respectively. Then how online platform will support to engineering students is as discussed below.

Placement capability of this student is calculated by using established relation based on binary logistic regression model.

$$Y = e^{(0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414)} / (1 + e^{(0.379X_1 + 0.283X_2 + 0.498X_3 + 0.13X_4 - 14.414)})$$

$$= 0.6484$$

Placement capability of this student is found out as 0.6484 i.e., 64.84%. The prediction accuracy of this model is 86.7 %. The performance of this student compared with optimum values of Aptitude, Communication, Technical and Personality skills to find out gap as shown in table 12.

Table 12. Skill gap and ranking of skills

Employability skills	Optimum values	Students' performance	Skill gap	Ranking
Aptitude skill	20.17	8	12.17	1
Communication skill	19.87	10	9.87	2
Technical skill	19.40	15	4.40	4
Personality skill	20.02	13	7.02	3

The above table 12 shows that the students need to enhance their employability skills up to optimum level to achieve 100 % placement capability for IT sector. The strong in one skill is not enough to get early placement. Students need to make systematic plan to raise skills up to optimum level to have maximum placement

capability in IT sector during campus placement selection process. The online platform can be used to check placement capability and find the skill gap of the students. The following report in figure 8 is generated for the above student by using the online software.

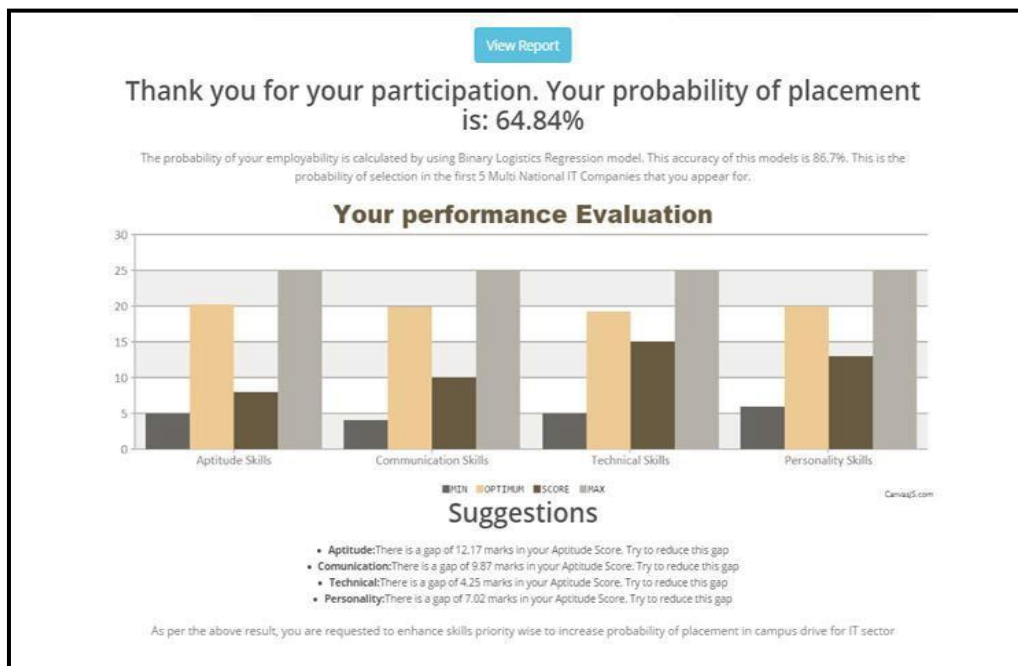


Figure 8. Report of a participated student

7. Conclusions

The analysis of result reveals some important inferences related to placement capability. The some major conclusions are drawn and presented as below:

- Aptitude skill along with technical skill is the deciding skills for campus selection in early attempts.
- Strong on one skill cannot facilitate 100 % placement capability in IT sector multinational companies.
- Based on sensitive analysis, the students have to score more than 18, 16, 16 and 17 out of 25 in Aptitude, Communication, Technical and Personality skill respectively to maximize Placement capability in IT sector.
- Based on the opinion of stakeholders, the optimum level of employability skills i.e. Aptitude, Communication, Technical and Personality skill scores are 80.7% (20.17), 79.5% (19.87), 77.6% (19.25) and 80.1% (20.02) respectively. This indicates that students need to raise their performance up to optimum value to achieve 100 % Placement capability.
- Binary logistic regression model for Yes/No output dataset is more suitable for this type of research problem.

References

- [1] Manda Sreeram and Kumar Naresh 2012 Status of technical education in India-Emerging issues and challenges Scribd digital library pp 67-72
- [2] Sodi Jasbir 2017 Need For Bridging The Industry-Academia gap International Journal of Engineering Development and Research vol 5(4) pp 1243-55
- [3] Phulsunge Sangeeta and Kalbande Vijay 2019 Importance of intrapersonal and interpersonal skills to make work ready professionals International Journal of Management, Technology and Engineering vol 9(1) pp 1411-1416
- [4] Vikhe Gautam and Agrawal Preeti 2014 Industry-Institute employability skill gap analysis IRD India vol 3(4) pp 17-19
- [5] Aspiring Minds report on National Employability study IT/ITeS sector 2014
- [6] Purple Leap study on low employability skills among engineering students, in Andhra Pradesh, published in Reachout's News Bureau 2009
- [7] Kalbande Vijay and Handa Chandrahas 2015 Identification of important parameters & skills required by engineering students in campus placement process International Journal of Engineering Research-Online A Peer Reviewed International Journal vol 3(2) pp 319-325
- [8] Kang Park and Peter Kerr 2012, Determinants of academic performance: A multinomial logit approach The Journal of Economic Education vol 21(2) pp 101-111 <https://doi.org/10.1080/00220485.1990.10844659>
- [9] Kalbande Vijay and Handa Chandrahas 2016 Developing a model to correlate employability of engineering graduate with employability skill sets in campus placement for IT sector Online International Interdisciplinary Research Journal vol 6(1) pp 128-137
- [10] Felder Richard, Forrest Krista, Baker-Ward Lynne 1993 A longitudinal study of engineering student performance and retention-I: success and failure in the introductory course Journal of Engineering Education vol 82 pp 15-21 <https://doi.org/10.1002/j.2168-9830.1993.tb00067.x>
- [11] Kalbande Vijay and Handa Chandrahas 2016 Developing a model to correlate employability of engineering graduate with employability skill sets in campus placement for IT sector Online International Interdisciplinary Research Journal vol 6(1) pp 128-137
- [12] Kalbande Vijay and Handa Chandrahas 2016 Predicting the performance of engineering students in campus placement for IT sector by using ANN International Journal of Research and Scientific Innovation vol 3(2) pp 109-113