

Computation of Academic Performance of Engineering Students

V. Venkatesh

Abstract — In engineering education, with an evaluation system comprising of both the continuous internal evaluation and the semester-end examination/external examination, the 'percentage of pass' may not be sufficient for rigorous analysis. In this proposed analytical approach, an attempt has been made to identify the important factors that could affect the performance of engineering students, quantify them and develop a mathematical expression for the purpose of analysis. This may help for self-appraisal, determination of deviations and remedial measures to be taken for the overall improvement in academic performance, teaching and learning process, and growth of the technical institutions/engineering colleges.

Index Terms — Academic performance, Analytical approach, Computation, Engineering education, Engineering students, Evaluation system, Important Factors.

1 INTRODUCTION

It is a challenging task to mould the engineering students into Engineers/Scientists/Academicians who are directly or indirectly responsible to build a better nation. Thus, engineering education plays a vital role and the performance of engineering students is very important for their success in the courses or entire programs/curricula. However, some deviations are being observed. The 'percentage of pass' may not be sufficient for rigorous analysis and thus calls for an analytical approach.

After completion of ten plus or pre-university courses, majority of the students may join engineering course irrespective of their interest and/or eligibility as per the parent's desire or as a prestige issue. Also, employment opportunities are more. But some students (even brilliants) may not perform well academically. This may in turn affect their future carrier.

On observation of many of such engineering students, collection of necessary data over a period of two decades and analysis, this proposed analytical method is developed identifying the important factors that could affect the academic performance of engineering students, which are quantified and expressed mathematically for the purpose of analysis. However, the thought is developed based on [1], [2], [3], [4], [5] and [6].

This analytical approach is applicable for an evaluation system comprising of both the continuous internal evaluation and the semester-end examination/external examination.

2 IMPORTANT FACTORS

- 1) Nature of the Students
- 2) Performance of the Faculty
- 3) Management Support
- 4) Continuous Internal Evaluation

5) Uncertainties

2.1 Nature of the Students

Nature (or quality of intake) of the students depends upon their level of intelligence and attitudes.

Based upon the level of intelligence, three possible categories are identified as given below:

- Above Average or Brilliant Students
- Average students
- Below Average Students or Slow Learners

The level of intelligence can be analysed based upon the available data of student's performance in ten plus or pre-university course, ranking in common entrance test/s, performance in internal assessment tests and semester end/external examinations.

Based upon the student's attitude, three possible categories are identified as given below:

- Hard working students
- Students with moderate efforts
- Students with minimum efforts

Attitude of the students is a psychological aspect, which depends upon the way they are brought up, their previous schooling, nativity such as rural/semi urban/urban arrears, parent's background, financial status, field of interest, learning environment of the engineering college, etc., which are subjected to variations.

In general, nature of the students can be mathematically expressed as

$$P_1 = \frac{N}{TSS} \quad (1)$$

where N = Number of students appeared for the semester-end examination and

TSS = Total strength of students of that particular subject/branch/department or college/institution.

A few students might have detained due to shortage of attendance, internal assessment marks (say, in laboratories), a few might have not attended the examination due to several reasons such as health related problems, transportation problems, unexpected incidents, wrong entry in examination ap-

V.Venkatesh is currently a Profesor with the Department of Electronics and Communication Engineering, C.I.T., Gubbi, Tumkur - 572216, Karnataka State, India, affiliated to Visvesvaraya Technological University, Belgaum 590018, India (e-mail: vvenkatesh_vve@yahoo.co.in)

plication form, and lack of interest and preparation etc.

$$\begin{aligned} \therefore N &= \text{Number of students appeared for the semester-end} \\ &\quad \text{examination} \\ &= \text{TSS} - (\text{Number of students detained} + \text{Number of absentees}) \end{aligned} \quad (2)$$

Note: The students who might have left the course/discontinued; change of branch/college/university, etc. will not be taken into account.

2.2 Performance of the Faculty

Performance of the faculty depends upon their knowledge, experience, teaching skills, and their attitude towards the profession (including their interest).

Usually, knowledge depends upon their Qualification (Q) - PG/Ph.D. degree and Experience (E).

The performance of the faculty can be computed by the available data of their Qualification, Experience and the Students Feed Back (SFB), expressed in percentage.

Performance of the faculty can be mathematically expressed as

$$P_2 = Q + E + \text{SFB} \quad (3)$$

Quantification:

25% & 30% is assigned for qualification, PG degree & Ph.D. degree respectively.

i.e.,

$$\begin{aligned} Q &= 25\% \text{ for PG degree holders} \\ &= 30\% \text{ for Ph.D. degree holders} \end{aligned}$$

50% is assigned for teaching experience as it is more accountable. It includes experience in industry/research organizations if any.

Thus, experience can be quantified as

$$E = 1\% \text{ for fresh PG holders or with teaching experience of one year}$$

$$= 5\% \text{ for five years of teaching experience}$$

$$= 10\% \text{ for ten years of teaching experience}$$

$$= 15\% \text{ for fifteen years of teaching experience}$$

$$= 20\% \text{ for twenty years of teaching experience}$$

$$= 50\% \text{ for more than twenty years of teaching experience}$$

20% is assigned for students feed back (SFB), which reflects the real teaching ability, knowledge and attitude of faculty. However, it also depends upon the attitude of the students.

SFB shall contain at least ten points such as depth of knowledge, command over the subject/language, vocabulary, presentation skills, punctuality/regularity, behavioral attitude, patience, coverage of syllabus, usage of teaching aids, etc.

The performance of the faculty can be graded as

Good: Faculty with PG/Ph.D. degree or ten to twenty years of teaching experience or SFB of 75% and above in that subject handled.

Satisfactory: Faculty with PG degree or minimum of ten years of teaching experience or SFB of minimum 50% in that subject handled.

Below average: Faculty with PG degree or fresh candidates/with one to two years of teaching experience or SFB less than 50% in that subject handled.

2.3 Management Support

The management shall provide the necessary requirements such as good faculty, necessary infrastructure, well equipped library, and encouragement for research work, co circular/extra circular activities. All these depend upon the financial strength and attitude of the management.

Quantification: Management support can be quantified as

$$M = 50\% \text{ for newly established institution or five years old}$$

$$= 75\% \text{ for more than five years old institutions}$$

$$= 100\% \text{ for more ten years old institutions}$$

Justification: In general opinion, newly established institutions may provide minimum requirements and ten or more than ten years old institutions may provide most of the requirements.

The other indirect factors such as hostel facility, quality of food, transportation, etc. are ignored as in this analytical approach, importance is given to the academic performance, and effective teaching and learning process.

2.4 Continuous Internal Evaluation

In a few technical institutions, some of the students are facing a severe problem that even though they might have scored minimum pass marks in the semester end (or external) examination, but fail in the 'result' of that particular subject/s due to shortage of internal assessment marks.

If a student is capable to get minimum pass marks in the external examination but could not get minimum internal assessment marks, then, it clearly indicates the poor performance of the faculty, irresponsibility/negligence, impatience, erratic valuation of internal tests, troubling nature (or even sadistic nature), lack of monitoring the student's performance, etc. in addition to the real performance of the students.

This will have a major set back on the future life of the students, painful for the concerned parents. Also, this will have an impact on reputation and annual income of the institution.

This can be mathematically given by

f = number of the students failed due to shortage of internal assessment marks.

If $f > 10$ number of students or if such failures occur repeatedly, then necessary action shall be taken against such (troublesome) faculty.

2.5 Uncertainties

Possible uncertainties are

- Difficult question paper (as per the students point of view)
- Question/s might have appeared from out of the syllabus
- Improper external valuation
- Postponement of examinations and/or reexamination

This can be mathematically expressed as

$$u = 4\% \times N$$

This may be considered for the benefit of the faculty under worst conditions such as very poor result. Otherwise, it can be ignored.

3 COMPUTATION OF ACADEMIC PERFORMANCE

Three possibilities will exist as follows.

First Possibility: Some students may pass with 'First Class with Distinction' (FCD), if they are above average and may work hard, performance of the faculty may be good and the management may provide all the necessary requirements, then all the three factors will be considered and added;

$$\text{i.e., } P_1 + P_2 + M = X \quad (\text{say}) \quad (4)$$

Second Possibility: Some students may pass with 'First Class' (FC), if they are above average/average and may work hard/put moderate efforts or performance of the faculty may be good/satisfactory or the management may provide all /most of the necessary requirements, then the best of any two factors will be considered and added;

$$\text{i.e., } P_1 + P_2 = Y \quad (\text{say}) \quad (5)$$

$$\text{or } P_2 + M = Y$$

$$\text{or } P_1 + M = Y$$

Third Possibility: Some students may pass with 'Second Class' (SC), if they are average/below average and may put moderate /minimum efforts or performance of the faculty may be satisfactory or the management may provide most of the necessary requirements/minimum requirements, then the best of any one of the factors will be considered only;

$$\text{i.e., } P_1 = Z \quad (\text{say}) \quad (6)$$

$$\text{or } P_2 = Z$$

$$\text{or } M = Z$$

Therefore, the academic performance of the students in the semester -end/external examination is given by

$$\eta = \frac{X(\text{FCD})}{X \times N} + \frac{Y(\text{FC})}{X \times N} + \frac{Z(\text{SC})}{X \times N} - \frac{f}{X \times N} + \frac{u}{X \times N}$$

$$\text{or } \eta = \frac{X(\text{FCD}) + Y(\text{FC}) + Z(\text{SC}) - f + u}{X \times N} \quad (7)$$

Expressing in percentage,

$$\eta = \left[\frac{X(\text{FCD}) + Y(\text{FC}) + Z(\text{SC}) - f + u}{X \times N} \right] \times 100 \quad (8)$$

Justification: Considering equation (7), on RHS, the denominator is given by

$$X \times N$$

Because, considering an ideal case that all the students (TSS) are above average and hard working, performance of the faculty is good and the management provides all the necessary requirements;

$$\text{Then, } P_1 = P_2 = M = 1$$

$$\text{Thus, } X = 1 + 1 + 1 = 3$$

$$\text{and } TSS = N$$

Therefore, all N students will pass with FCD (eventually Y,

Z, f and u will not exist). Therefore, equation (7) becomes

$$\eta = \frac{X(\text{FCD})}{X \times N} = 1$$

The result of revaluation/challenge revaluation can be taken into account.

4 CONCLUSION

This analytical approach helps to evaluate the academic performance of engineering students and the faculty; subject wise or departmental wise or overall performance of the technical institution. The deviations can be exactly identified and the remedial measures such as effective proctorial system or students counseling, extra/additional classes for slow learners and conduction of awareness/orientation/other initiative programs for the students, and faculty development programs/ skill development programs for the faculty, disciplinary action against troublesome faculty, etc. can be taken. Thus, the institution achieves academic excellence, good reputation and helps for overall growth. This analytical approach may be applicable for UG (as well as PG) courses/programs/curricula with an evaluation system comprising of both the continuous internal evaluation and the semester end examination/external examination. Also, suitable software can be developed.

Of course, this approach may not be applicable for all the engineering colleges/technical institutions.

REFERENCES

- [1] McCaulley, M.H., "Psychological Types of Engineering Students – Implications for Teaching," Engineering Education, vol. 66, no. 7, Apr. 1976, pp. 729-736.
- [2] McCaulley, M.H., E.S. Godleski, C.F. Yokomoto, L. Harrisberger, and E.D. Sloan, "Applications of Psychological Type in Engineering Education," Engineering Education, vol. 73, no. 5, Feb. 1983, pp. 394-400.
- [3] Godleski, E.S., "Learning Style Compatibility of Engineering Students and Faculty," Proceedings, Annual Frontiers in Education Conference, ASEE/IEEE, Philadelphia, 1984, p. 362.
- [4] Waldheim, G.P., "Understanding How Students Understand," Engineering Education, vol. 77, no. 5, Feb. 1987, pp. 306-308.
- [5] Felder, R.M., "On Creating Creative Engineers," Engineering Education, vol. 77, no. 4, Jan. 1987, pp. 222-227.
- [6] Bain, R. (1928) An attitude on attitude research. American Journal of Sociology, 33, pp. 940-957.