FACTOR ANALYSIS SCORES IN MULTIPLE LINEAR REGRESSION MODEL FOR PREDICTION OF FACULTY PERFORMANCE IN HIGHER EDUCATION INSTITUTIONS
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ABSTRACT:

Performance evaluation of faculty in higher education institutions is a challenge for education managers considering the diversity of disciplines. Though University Grants Commission (UGC) has given a format based on Academic Performance Indicators (API) many a times education managers face uncertainty in making decisions on the quality of performance as the scores are numerical and do not consider the subjective component involved in teaching learning process. The API format also includes several criteria like teaching, co curricular, research and feedback. The score of faculty across all these criteria indicates their overall performance which is used in decision making with regard to increment, promotion, etc. Measuring performance without considering the variation in each of these criteria may not yield good decisions. Hence, a statistical model which can assess the dependency and independency of the criteria was used to evaluate which of these criteria have maximum influence on the overall performance scores of the faculty.

In this study, multiple linear regression model is used to assess faculty performance wherein the total score of the faculty API score is taken as dependent variable and the teaching learning evaluation, co curricular activities, research and feedback are considered as independent variables. Factor scores obtained by factor analysis were used for multiple linear regression analysis using the SPSS software.

Key words: Faculty performance evaluation, higher education institutions, multiple linear regression analysis.

[1] INTRODUCTION

Higher education institutions play a significant role in today’s world as contributors to nation’s economy. Teachers are the drivers of these higher education institutions. An institution of repute boasts of quality faculty as its strength. Teacher’s quality is a matter of concern...
wherein many education managers often face a challenge. Recruiting good faculty and retaining them is a challenge for human resource managers because of the surge in the number of higher education institutions and the demand for qualified experienced faculty. Human resource management practices often reflect on the organization’s culture and policy and the employee’s performance is influenced by these practices. Job satisfaction and motivation are directly dependent on the support extended by the management for their career growth and development.

The educational sector is witnessing enormous expansion and hence the need for evaluation and assessment of these institutions is also increasing. This demands a greater accountability by higher educational institutions in terms of their contribution to the society as well as to the nation. Several agencies rank the best universities not only in the country but also globally. One of the important parameters for their ranking is the quality of faculty. This has led to a growing emphasis on performance appraisal for academic staff. Staff appraisal has been considered as a highly important issue that should be effectively embraced by academic professionals as an essential aspect of their work. As well as understanding the effects of performance appraisal and measurement institutions also need to have an understanding of how to design more effective systems for performance evaluation and incentive compensation. Managers are measuring, evaluating, compensating, designing and changing their systems constantly [1].

According to Bush and Middlewood (1997), people are the most important organisational resource [1]. In higher education institutions, this is all the more important as the delivery of teaching learning happens through human resource. Though modern teaching integrates human factor with technology but it is the capability of the faculty which can make a difference in the learning process. The skills and abilities are greatly enhanced by using modern technology and benefit both the faculty as well as the students. Human Resource Management therefore is of critical importance in educational management because educational organisations are service organisation providing a service to their community, to parents, and to students. Quality of service depends directly on the capability, commitment, and motivation of people who provide it. The human resources available to educational organisations thereby constitute both their most valuable asset and their greatest management challenge (O’Neill, 1994a). “No organisation can depend on genius; the supply is always scarce and unreliable. It is the test of an organisation to make ordinary people perform better than they seem capable of, to bring out whatever strength there is in its members, and to use each person’s strength to help all the other members perform” (Drucker, 1988, p.361) [1].

Managing performance not only affects the employee’s performance but also the performance of the entire institution. Managing performance in an organisation involves informing employees what is expected of them, how they are contributing, and how they improve. Only then can the employees excel, use their abilities to the fullest, and feel connected to their organisation (Costello, 1994)[1]. In education it has been argued that “the goal of a great appraisal system is for professional development. It is neither the ranking or grading of teachers nor the weeding out of poor teachers, it is to create an environment where everyone is used to the best of their abilities” (Bradley, 1992, p. 127). Performance appraisal may also be
defined as “an on-going systematic evaluation of how well an individual is carrying out the duties and responsibilities of his or her current job. Additionally, it typically includes an assessment of the individual’s need or potential for further development” (Caruth, 1986, p. 235).

Studies have been conducted in Higher Educational institutions; the study by Hutchinson at the University of Ulster (1995), the study at the University of Wessex (1998), and the study by Rutherford at the University of Birmingham (1988). These studies emphasized on the need for evaluation of performance of faculty and also the method of evaluation [1].

Performance appraisal method can influence the faculty performance as a reliable and trustworthy method which is transparent builds confidence among the faculty. The results of the method when used by the management for appraisal of faculty at times of increment, promotion, demotion, transfers can motivate the employees to perform better.

Education is targeted at the development of human potential, moreover the development of a climate aimed at effective learning and teaching cannot be achieved without taking into consideration the sensitive management of people working in the schools and colleges (Bush and Middlewood, 1997). Recently, theorists of higher education have acknowledged that performance indicators lead to control, evaluation, innovation and prediction in education [2].

In this study an attempt was made to use multiple regression analysis in evaluating faculty performance and assessing the independent and dependent variables in the format. Multiple regression analysis is one of the most widely used methodologies for expressing the dependence of a response variable on several predictor variables. In spite of its evident success in many applications, however, the regression approach can face serious difficulties when multicollinearity is present among the independent variables [4]. The specific goals of principal component analysis are to reduce a large number of predictor variables to smaller no. of principal components and to provide a regression equation for an underlying process by using predictor variables. Principal components can be derived such that they are nearly uncorrelated or orthogonal. Thus the problem of multicollinearity among the variables, which are used to estimate the BP reactivity of subjects, can be solved by using PCA [4].

[2] REVIEW OF LITERATURE

There is an increasing use of the performance appraisal process (Carrol & Schneir, 1982; Ishaq, 2009; Dechev Z., 2010) which is mostly motivated by an organizational need to have an effect on employee’s attitudes, behaviors and eventually, organizational performance (Murphy & Cleveland, 1995). Based on many researches (Ayaz, n.a; Dechev Z. August, 2010), the most winning organizations in the 21st century will be those to focus on integrated HR processes and systems. So the role of human resource becomes more and more vital which includes personnel related areas such as job design, resource planning, performance appraisal system, recruitment, selection, compensations and employee relations (Derven, 1990).

Among these functions, one of the most critical ones that bring global success is performance appraisal (Marquardt, 2004). Performance appraisal is considered to encourage employee performance in consequent performance cycles (Heneman & Werner, 2005).
The quality of performance assessment depends on the indicators that are used to measure them which are mainly the clarity of performance expectations, level of communication between the employees and their supervisors, trust in the supervisor, fairness of performance appraisal process (Fortin, 2008). The aim of a quality approach is to reduce variation in each process in order to get greater consistency (Roberts & Sergesketter, 1993). Most researches in the field suggested using four approaches to assessment, including assessment by students, peer assessment, self-evaluation and evaluation by managers (Safi et al, 2011).

There are also a number of studies which support the argument that performance appraisal has remained a problem which is vague and perhaps unsolvable in human resource management (Schay, 1993).

Georgia State University studied faculty members’ annual performance evaluation by the philosophy that evaluation must be something more than a mere evaluation. Flexibility, encouraging, professional development, and efforts to improve school standards are among their aims. Faculty evaluation will be based on two main criteria. Evaluation of teaching, research and service and evaluation of developmental activities for flexibility, five-set or job description (traditional, educational, research, service and management), with clear expectations and objectives [2].

At Sam Houston State University studied faculty members’ evaluation in a systematic and comprehensive way. The system is designed to increase objectivity and reducing bias. There are four criteria: effective teaching approach, working professionals and researchers, and professional development activities and non-academic activities of the faculty members and each of these criteria are weighted. The system attempts to take the subjectivity out of the evaluation and consider the effectiveness criteria [2].

Johns Hopkins University School of Nursing in America provided a comprehensive and evidence-based evaluation system for faculty members which end-stage data is provided for horizontal and vertical ongoing development and promotion decisions. In this system, three sources (students, peers, and school records) are used for evaluation. Both the coaching and management structure are created for effective use. Using such comprehensive and evidence-based systems is necessary to documentize, analyze and improve the effectiveness of training, ensuring the quality of teaching and learning (Appling et al, 2008) [2].

Employees are sensitive to quality variations in performance appraisal as its processes are a powerful determinant of employees’ futures such as having promotion, rewards, demotion or even termination of their job within the organization (Mayer & Davis, 1999). Thayer (1987) suggested performance appraisal quality variations will generate strong reactions among employees. Organizational efficiency can be affected by the quality of the performance appraisal process (Brown, Haytt, & Benson, 2010) [3]. Hence it is not only the performance appraisal but even the method used to evaluate performance can have significant role in the evaluation process which in turn affects the performance of employees.

[3] NEED FOR THE STUDY

The conventional methods used for faculty performance evaluation may lead to uncertainties and loss of faith in the system by the faculty. Hence an attempt was made to use
multiple regression analysis for evaluating faculty performance based on API scores in higher education institution.

[4] METHODOLOGY
This is a descriptive study to analyse whether or not the four independent variables in the API proforma were significantly predictive of the API score—the dependent variable based on the ANOVA statistics as depicted in the following figure 1:

![Figure 1: Relationship between parameters](image)

[5] DATA COLLECTION
The data for the present study was collected from JSS University under UGC, Govt. of India from medical, dental and pharmacy colleges teachers (N=386). The performance appraisal proforma was prepared based on UGC guidelines with three categories viz., Teaching methodology, Co-curricular, Research and feedback from students, peer and heads of the department in which 22 parameters were considered and each parameter was assigned a numerical value (marks) based on their importance.

[6] DATA ANALYSIS
For Factor analysis, we used SPSS software (version 22). The factor analysis provides dimension reduction without losing the original information as 5 factors which comprises more than 65% of the total variance after varimax rotation. KMO measure of sampling adequacy [5] and Bartlett’s test of sphericity [6] were performed to test the applicability of PCA on the collected database.

**Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy** is used to examine the appropriateness of factor analysis. The KMO statistic varies between 0 and 1. For this data the value is 0.5, so we should be confident that factor analysis is appropriate for this data.

**Bartlett’s test of sphericity.** Bartlett's test of sphericity is used to test the hypothesis that the Original correlation matrix is an identity matrix. A significant test tells us that the R- matrix is not an identity matrix: therefore, there are some relationships between the variables we hope to include in the analysis. For this data, Bartlett’s test is highly significant (p<0.001), and therefore factor analysis is appropriate.
[7] RESULTS

Factor scores were considered as independent variables for predicting the dependent variable using multiple regression model:

The regression analysis yields the following equation for determining the dependent variable total score:

\[
\text{Total API score} = 196.561 + 37.187 \times FS_1 + 26.486 \times FS_2 + 13.708 \times FS_3 + 22.312 \times FS_4 + 15.877 \times FS_5
\]

Significance (0.000)

\(a = 196.561\) is the regression constant.

\(b_1 = 37.187, b_2 = 26.486, b_3 = 13.708, b_4 = 22.312, b_5 = 15.877\) are regression coefficients.

FS\(_1\), FS\(_2\), FS\(_3\), FS\(_4\) and FS\(_5\) are the factor scores.

The factors that proved to be significant in relation to the API scores are teaching, learning evaluation, co curricular activities, research and feedback. This indicates that there is a positive sign of the coefficients of the variables teaching, learning evaluation, co curricular activities, research and feedback.

The significance of the regression coefficient was tested with one way ANOVA test while the goodness –of –fit of the regression was assessed using the coefficient of determination (R\(^2\)) and adjusted R\(^2\) (Table 1). SPSS statistical software was used to analyse the data.

The regression equation was found to be significant at the 0.05 significance level (95% confidence) with an F-value of 581.378 and a significance of 0.000. The coefficient of determination R\(^2\) for this regression analysis is 0.900 meaning that 90% of the variation in the dependent variable is explained by variations in the independent variables. An R\(^2\) of 0.900 is considered to be an acceptable level for the regression to be significant as long as this research is for appraisal purpose. 10% of the explanation cannot be attributed to the regression analysis but to other factors not considered in this study.

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>R Square Change</th>
<th>F Change</th>
<th>df1</th>
<th>df2</th>
<th>Sig. F Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.949(^a)</td>
<td>0.900</td>
<td>0.899</td>
<td>18.43826</td>
<td>0.900</td>
<td>581.378</td>
<td>5</td>
<td>322</td>
<td>0.000</td>
</tr>
</tbody>
</table>

\(a.\) Predictors: (Constant), REGR factor score 5 for analysis 1, REGR factor score 4 for analysis 1, REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

\(b.\) Dependent Variable: GT6

Table 1: Model Summary for dependent variable

The regression equation was found to be significant at the 0.05 significance level (95% confidence) with an F-value of 581.378 and a significance of 0.000. The coefficient of determination R\(^2\) for this regression analysis is 0.900 meaning that 90% of the variation in the dependent variable is explained by variations in the independent variables (Table 2). An R\(^2\) of
0.900 is considered to be an acceptable level for the regression to be significant as long as this research is for appraisal purpose (Table 1). 10% of the explanation cannot be attributed to the regression analysis but to other factors not considered in this study.

Table 2: Results of One way ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>988253.784</td>
<td>5</td>
<td>197650.757</td>
<td>581.378</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>109470.182</td>
<td>322</td>
<td>339.970</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1097723.965</td>
<td>327</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: GT6
b. Predictors: (Constant), REGR factor score 5 for analysis 1, REGR factor score 4 for analysis 1, REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

Table 3: Co-efficient results

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>196.561</td>
<td>1.018</td>
<td>193.070</td>
</tr>
<tr>
<td></td>
<td>REGR factor score 1 for analysis 1</td>
<td>37.187</td>
<td>1.020</td>
<td>.642</td>
</tr>
<tr>
<td></td>
<td>REGR factor score 2 for analysis 1</td>
<td>26.486</td>
<td>1.020</td>
<td>.457</td>
</tr>
<tr>
<td></td>
<td>REGR factor score 3 for analysis 1</td>
<td>13.708</td>
<td>1.020</td>
<td>.237</td>
</tr>
<tr>
<td></td>
<td>REGR factor score 4 for analysis 1</td>
<td>22.312</td>
<td>1.020</td>
<td>.385</td>
</tr>
<tr>
<td></td>
<td>REGR factor score 5 for analysis 1</td>
<td>15.877</td>
<td>1.020</td>
<td>.274</td>
</tr>
</tbody>
</table>

a. Dependent Variable: GT6 (Overall performance score)

The regression analysis of co-efficient (Table 3) yields the following equation for determining the dependent variable:


(Significance) (.000) (.000) (.000) (.000) (.000)

The factors that proved to be significant in relation to overall faculty performance were teaching learning evaluation, co curricular, research and consultancy and feedback. All the factors showed positive correlation which emphasizes that teacher should give importance to all activities rather than on teaching alone especially in higher education institutions. The
academic managers should provide conducive environment for promoting such activities through faculty development programmes. This analysis can help assess faculty performance across various parameters in the API format and recognize in which areas they are underperforming and thereby provide opportunities for development. Faculty performance evaluation results need to be scientifically based and the same to be communicated to faculty in order to realize their potential for further career progression. The role of academic managers in ensuring quality faculty in higher education institutions is significant in improving the overall performance of the institutions.

[8] DISCUSSION

Regression analysis findings suggest that the academic performance of faculty is significantly correlated with teaching, learning evaluation, co-curricular activities, research and feedback. The overall assessment of faculty performance need to consider their performance across all domains.

This study has shown that performance appraisal as one of the important tasks for human resource department in higher education institutions. Its implementation and assessment needs to consider the uncertain areas and address the same before the results are communicated to the faculty.

Benefits of performance appraisal to the faculty include:
- Provides better assessment of strengths and weakness of individual performance.
- Provides better feedback systems with effective communication of the results
- Provides opportunities for betterment of performance by identifying areas for improvement.

Benefits for university include:
- Provide uniform method of evaluation irrespective of disciplines
- Help identifying best performers amongst faculty
- Providing opportunities for training and scope for improvement
- Help to keep the staff motivated
- Better learning organization with collaborative atmosphere

[9] CONCLUSION

The world’s economy is expanding and the contribution of higher educational institutions as knowledge drivers is undisputed in terms of economy. Teachers play a significant role as knowledge contributors and therefore their performance is a matter of concern for the education managers. Designing appropriate performance appraisal method and implementing it to employee’s satisfaction needs to be advocated by all higher education institutions. Appraisals should not only provide means for measuring their performance but also provide avenues for further growth and development of individuals. Systematically designed appraisal mechanisms can align individual goals with organizational goals and help both grow. According to Senge (1990), the organisations that will truly excel in the future will be the ones that discover how to initiate people’s commitment and capacity to learn at all organisational levels[1]. In this study, we used multiple regression analysis as a model to test the relationship between
independent and dependent variables and in predicting faculty performance. This can serve as one of the effective tools for performance evaluation of faculty in higher education institutions and when used effectively can provide reliable data for management for decision making with regard to faculty increments, promotions, transfers as well as terminations. Academic managers need to adopt appraisal methods that ensure transparency in evaluation as well as help design training modules for furthering faculty development.

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Publications:


**Author(s) brief Introduction**

Dr. H.K. Mamatha is working as assistant professor in the department of health system management studies, Jagadguru Sri Shivarathreeshwara University, Mysuru. She is also pursuing her PhD in Management of Higher education with a focus on faculty performance evaluation in higher education institutions. She is involved in designing curriculum for the MBA programme as well as coordinating the various activities of the department. She has participated in several national and international conferences and presented research papers. She is also the associate editor for JSSUNI newsletter and IJHAS journal.