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Parametric Approach for Effective Educational Management System through Data Analytics

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***Abstract*—Every higher education institute is focusing on offering quality education to the students. Academic performance of the student plays key role in analysing the effectiveness of academic performance factors in the educational management system. Authorities of engineering colleges are more worried about academic performance of the students.The main aim of this paper is to identify parameters affecting educational management system. The primary data is collected from different stakeholders of educational management system through questionnaires, observations and interview techniques. The analysis interpreted that there are few student, faculty and institute related factors which have significant effect on the academic performance of the students' and so on educational management system. The study reveals that special attention should be given on curriculum structure, recent trends, infrastructure,teaching learning process. This will help in enhancing the quality of teaching, industry institute interaction and placement ratio in any educational organization. Primary data is collected from 30 engineering colleges.**

***Index Terms*— Educational management system, Factors, Data Analytics.**

I. Introduction

Every higher education institute is focusing on offering quality education to the students.Educational institutions are playing an important role in our society and playing a vital role for growth and development of Nation. Prediction of student's performance in educational domain is important. Student's academic performance is based on various factors related to student personal and educational details. In higher education institutes, the failure in academics is becoming the subject of anxiety and worry. Due to the poor academics, the students are dropping out after their enrollment.

II. Literature Review

Educational management system is considered with different stakeholders of it who are playing key roles in the educational management system such as management, regulatory bodies, university, administrator, principal, faculty, students, industry experts and parents.
Education system stands on five important pillars i.e. Management,Teacher, Student, Parent, and Industry Expert. Teachers play an important role in shaping the students by imparting the knowledge using various teaching learning methods, from blackboard teaching (chalk and talk) to the present scenario (ICT based).

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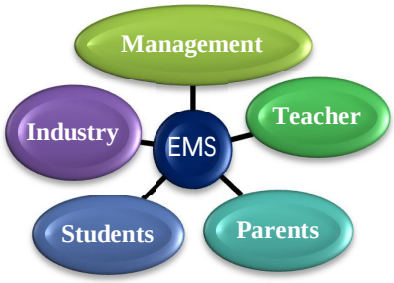

Fig1: Education Management System (EMS) Stakeholders

In the essay [1],data was collected of students studying degree programmes from different faculties at the University of Mauritius.After doing factor analysis data is analyzed using logistic regression. Different factors affecting quality of higher education such as student to staff ratio, class strength, teaching qualification were identified. Ritika Mahajan et al [2] gathered data from MBA students and alumni through questionnaires. They proposed a framework which showed the interrelationships of the factors which play key role in the improvement of quality of management education.

In the study [3] it is mentioned that educators or teachers are more worried about students' good grades, job opportunities and the subject learning and performance. Educators are creating new opportunities for learning and engaging students for their betterment. Due to change in technological trends over years, analytics is one of the major trends helping in improving the quality of education. Many educational institutions are using analytics. Student retention is one of the most discussed issues in the higher education sector. Predictive analytics is important solution to find out students with risk in dropouts and make appropriate interventions in a timely manner to maximize retention.

The authors [4] did the study to investigate the factors supporting to students learning process. The study is related to relationship between student's satisfaction and system use. The results showed that student satisfaction has made the strongest impact on perceived usefulness compared with the other independent variables. Dr. N. V. Gudaganavar and Dr. S. V. Hegadal [5] assessed the relationship between job satisfactions of teachers, teaching effectiveness of teachers, work motivation of teachers and IQ of students with academic achievement. The author [6] analyzed the academic performance of students of System Design course. He built system usable for regression analysis (SUAR) to evaluate the teaching learning process about the design of intelligent applications. The independent variable is SUAR and dependent variable is student performance (grade). María Esther Urrutia-Aguilar et al collected data from first year medical students through questionnaires based on general knowledge, psychosocial factors, factors associated to career choice. Logistic regression model was used based on academic background, percentage of marks, general knowledge, and aptitude interest in biological science to identify the students who are at risk and to provide efficient strategies to ensure that students complete their medical training. Logistic regression model described the relationship between independent and dependent variables that predicted academic performance among the first-year medical students. R statistics tool was used for data analysis [7].

Agasisti & Bowers [8] collected the data about the educational activities and processes. The information stored in knowledge management system that facilitates the interactions between students and teachers is helpful for analyses. The data analyses are useful for policy makers to use the data for implementing, managing and evaluating policy interventions. Analyses are also useful to higher authorities for managerial purpose and teachers for the purpose of improving teaching effectiveness which helps to improve students' academic performance.

Mahesh Gadhavi and Dr. Chirag Patel [9] gathered marks of internal examination components of one subject to predict the final grade in the subject. The model provided predicted grade of final examination in particular subject. Authors state that the model helps students to know how many marks are required to get particular grade. Abdelaal Abdellatif Fadul and Khalda Osman Abd Elghafar Mohammed [10] collected data from school children through questionnaires in two groups as urban and rural. The authors built logistic regression model to examine the socio economic and demographic factors affecting basic school dropout. The authors concluded that the education of the head of the family seems to have strong associations with attendance rate.

III. Problem Statement and Objectives

Technology enables the use of new approaches to formative and predictive assessment. Accreditors use the metrics such as student faculty ratio, library facilities, laboratory facilities, teaching quality, academic results etc. to determine educational institutes'grades.The objectives of the study are as below:

1. To identify the parameters affecting educational management system.
2. To identify the educational performance factors affecting educational management system.
3. To explore data analytics strategies for educational management system and effectiveness.
4. To propose data analytics modelfor an effective educational management system.

IV. Data Analytics in Educational Management System

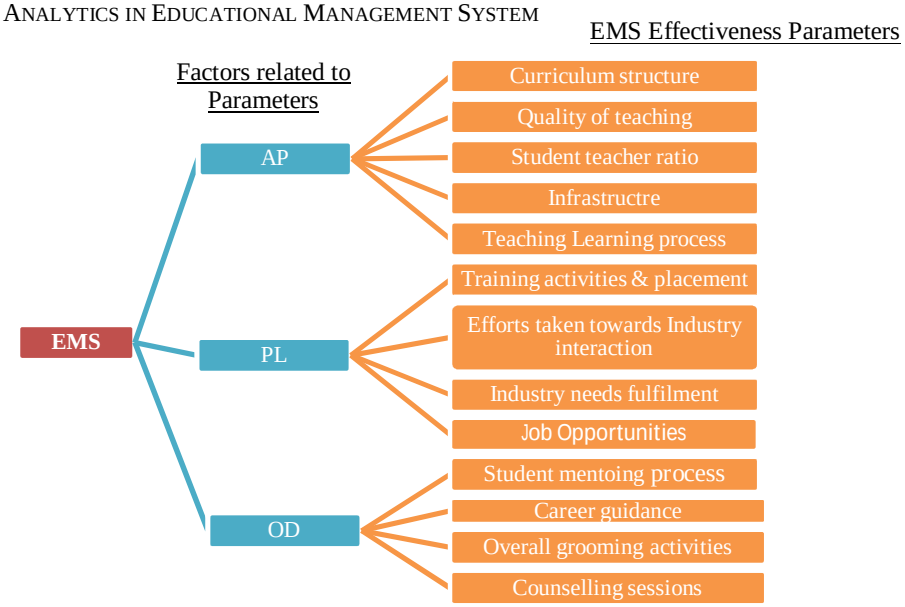

Fig 2: EMS Parameters and Corresponding Factors

The study is aimed to describe relationship between different variables related to educational management system.

The questionnaire based survey is used to collect Likert-scale responses from five main stakeholders of educational management system (Principals, Teaching faculty members, Students, Industry Experts, Parents). The primary data is collected through questionnaires, observation and interview techniques. The educational management system effectiveness parameters are identified based on responses received from the respondents. It is observed that EMS parameters can be classified into three broad categories: Student academic performance (AP), Student Placement (PL), and Overall development of students (OD). As shown in fig 2 EMS parameters are affected by related factors. Confirmatory Data Analysis is applied for proving the hypothesis. Relations between parameters and corresponding factors are analyzed using Exploratory Data Analysis method.

V. Data Analysis and Findings

The main objective of the study is identifying factors affecting academic performance of engineering students. SPSS23 was used for analysis purpose.

A. Academic performance of student in university examination

a. Dependent Variable: Academic performance of student in examination
b. Independent Variables: Curriculum structure, Quality of teaching, Student teacher ratio, Infrastructure,teaching learning process, Student teacher ratio

B. Placement

a. Dependent Variable: Placement

b. Independent Variables:Job opportunities for the course, Industry needs fulfilment, Efforts towards Industry Institute Interaction, Training activities conductedand placement

C. Overall development of the students

a. Dependent Variable: Overall development of the students
b. Independent Variables:Student mentoring process, Counseling of the students, Career guidance support, Efforts taken for overall grooming of the students

Multiple regression analysis is done on collected data.

1. Student academic performance

TABLE I: MODEL SUMMARY FOR STUDENT ACADEMIC PERFORMANCE

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.995[a]	.990	.990	1.22353	1.977

TABLE II: ANOVA F-TEST

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18507.973	5	3701.595	2472.651	.000[b]
	Residual	181.139	121	1.497		
	Total	18689.111	126			

Referring the last column of table 2 (Sig. =.000) reveals that the regression model is highly significant to fit the data.

To know which predictor variables makethe model significance, can be examined by the coefficient table (t-test) in table 2below.The cumulative effect of the set of predictor variables on the response variable is highly significant which can be examined by the coefficient table (t-test) in table 3 below.

TABLE III: COEFFICIENTS TABLE FOR STUDENT ACADEMIC PERFORMANCE

Variables			Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-0.136	0.176		-0.515	0.608
Curriculum structure	0.841	0.082	0.833	10.268	0.000
Approach to teaching learning process for the students by teacher in institute	0.701	0.132	0.699	5.324	0.000
Student teacher ratio	0.136	0.198	0.108	0.688	0.000
Quality of teaching	0.591	0.187	0.489	3.153	0.051
Infrastructure in the institute	0.523	0.061	0.512	8.537	0.000

The multiple linear regression equation for academic performance of the student is given by:

$$Y_1=-0.136+0.833X_1+0.699X2+0.108X_3+0.489X_4+0.512X_5 \quad (1)$$

It has shown that curriculum structure and approach to teaching learning process is highly significant with B = 0.833, B = 0.699 and p = 0.001 respectively. This indicates that when curriculum structure is based on industry requirements then teaching approach would be more practical oriented. This automatically enhances the teaching quality.Students' academic performance can also be enhanced by making balanced student teacher ratio. This will help teachers in understanding the main areas of students in better way.

2. Placement

TABLE IV. MODEL SUMMARY FOR PLACEMENT PARAMETER

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.998[a]	.997	.997	1.02880	2.147

Analysis of variance (F-test) part of regression analysis shows that the overall model is significant or not. Referring the last column of table 5 (Sig. =.000) reveals that the regression model is highly significant to fit the data.

TABLE V: ANOVA F-TEST

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	77713.472	3	25904.490	24474.617	.000[b]
	Residual	267.781	253	1.058		
	Total	77981.253	256			

The cumulative effect of the set of predictor variables on the response variable is highly significant.

Y_2=-0.10+0.071X_1+1.004X_2-0.132X_3+0.048X_4 (2)

It has also shown that fulfilment of industry needs in the institute is highly significant with B = 1.004 and p = 0.001. This indicates that industry needs are being fulfilled bycurriculum structure based on present industry requirements with hands on practical sessions.More focus on problem solving exercises based on communication skills, aptitude skills and reasoning skills is needed.As it shows more emphasize need to be given on training and placement activities, industry institute interaction by arranging different workshops and guest lectures by industry experts, memorandum of understanding with industry which will help for campus placement. The different data analytics strategies for educational management system and their effectiveness are mentioned in the analysis and above results.

TABLE VI: COEFFICIENTS TABLE FOR STUDENT PLACEMENT

Variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-0.10	0.145		-0.067	0.947
Curriculum structure	0.066	0.065	0.071	1.009	0.318
Fulfilment of industry needs in the institute	1.009	0.087	1.004	11.627	0.000
Training and Placement activities in the institute	-0.130	0.051	-0.132	-2.553	0.014
Efforts taken to increase Industry Institute Interaction	0.052	0.064	0.048	0.817	0.417

3. Overall development of the students

TABLE VII MODEL SUMMARY FOR OVERALL DEVELOPMENT

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.998[a]	.997	.997	1.02880	2.147

Analysis of variance (F-test) referring the last column of table 8 (Sig. =.000) reveals that the regression model is highly significant to fit the data.

TABLE VIII: ANOVA F-TEST

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	77713.472	3	25904.490	24474.617	.000[b]
	Residual	267.781	253	1.058		
	Total	77981.253	256			

(Sig. =.000) reveals that the regression model is highly significant to fit the data.The cumulative effect of the set of predictor variables on the response variable is highly significant as reflected in coefficient table (t-test).

TABLE IX: COEFFICIENTS TABLE FOR OVERALL DEVELOPMENT OF THE STUDENTS

Variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.010	0.881		0.887	0.382
Student mentoring process	0.236	0.207	0.197	1.145	0.261
Career Guidance for the future of the student	0.215	0.152	0.211	1.416	0.159
Counselling of the academic performance improvement	-0.468	0.086	-0.453	-5.416	0.000
Infrastructure	0.291	0.060	0.293	4.840	0.000
Approach to teaching learning process for the students by teacher at institute	0.347	0.114	0.346	3.029	0.003

$Y_3=1.010+0.197X_1+2.11X_2-0.1453X_3+0.293X_{4+}0.346X_5$ (3)

It has also shown that approach to teaching learning process for the students by teacher in instituteis highly significant with B = 0.346 and p = 0.003. This indicates that teaching learning process needs to be based on hands on practical sessions. More focus on mini projects, application oriented practical assignments is needed.It shows more emphasize need to be given on counselling and career guidance, as both are important for the students to make them aware about how their academic improvement is important for their better future.The different data analytics strategies for educational management system and their effectiveness are mentioned in the analysis and above results.

D. Findings

1. Objective 1: To identify the parameters affecting educational management system.
   Identified EMS parameters are academic performance of student in university examination, Placement and Overall development of the students.
2. Objective 2: To identify the educational performance factors affecting educational management system.
   Factors affecting EMS performance are Curriculum structure, Quality of teaching, Student teacher ratio, Infrastructure, teaching learning process, Student teacher ratio, Job opportunities for the course, Industry needs fulfilment, Efforts towards Industry Institute Interaction, Training activities conducted, : Student mentoring process, Counselling of the students, Career guidance support, Efforts taken for overall grooming of the students
3. Objective 3: To explore data analytics strategies for educational management system and effectiveness.

Data Analytics Strategies	Purpose	Effectiveness on EMS
Regression Model	To identify significance to fit the model	The regression model is highly significant to fit the data.
Effectiveness of the Predictor variables	To identify the effectiveness of the predictor variables	The cumulative effect of the set of predictor variables on the response variable is highly significant.
Multiple linear regression equation	To identify significance of the factors	With the help of regression equation, factors are identified which are highly significant to the parameters of EMS.

4. Objective 4: To propose data analytics model for an effective educational management system.

VI. Proposed Model

The following model is proposed for predictive analytics in educational management system (EMS) which will be effective for better academic performance of the students. The researcher has identified the parameters and factors affecting educational management system. These parameters and factors will be used in the data analytics model for prediction. Results will be compared with preciously collected data. Effects are analysed for next assessment.

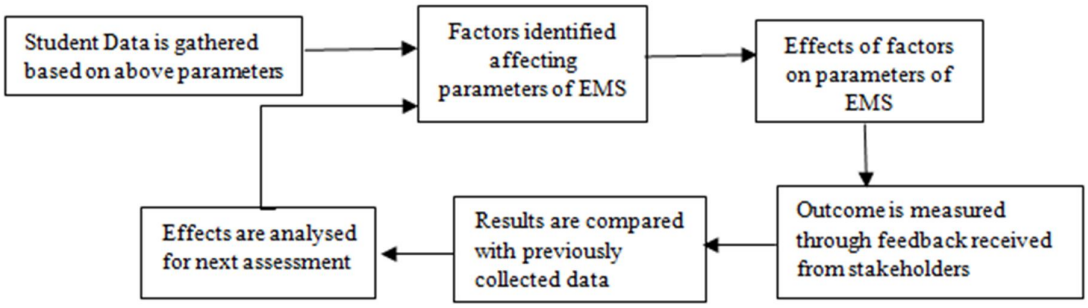

Figure 3: Model for Predictive Analytics

VII. Conclusion

From the literature review, different scholars discussed about the academic performance of the students. Few of them have focused on the different factors that affect students' academic performance. In the study, three main parameters affecting on educational management system are identified as academic performance of the students, placement and overall development of the students. From the inferential analysis of the study, it is evident that few factors have highly significant effect on the above mentioned parameters. That is curriculum structure, approach to teaching learning process, quality of teaching, infrastructure, job opportunities training and placement activities etc. From the results, it is evident that interesting teaching learning process like, well prepared faculty with good experience will enhance the academic performance of students. On the other hand institutional factors like, infrastructure, well equipment of workshop and laboratory enhance the achievement of engineering students. Special attention should be given on curriculum structure based on industry needs and recent trends, teaching learning process, industry institute interaction and placement activities to enhance the academic performance of engineering students. The model is proposed for predictive analytics in educational management system (EMS) which will be effective for better academic performance of engineering students.

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