

Six Sigma Perspective: Research, Digital Skills and Class Interactions as Dimensions of Quality

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Abstract

“There is a large gap between what students are learning and what the job market is looking for. The current curricula are outdated.” -South Asia Youth Consultation, UNICEF. The objective of this study is to measure the effective research in higher education as a dimension of quality, with respect to commerce and management streams, which can serve as one of the many factors needed to achieve six sigma. Also to develop a measure of higher education service quality from student's view and how can we improve the student satisfaction by using the tools of six sigma. Six Sigma is a data driven methodology for continuous improvement which has been successfully implemented in many service industries. Data for this research was collected from the primary stake holders of education services i.e. the students, who voluntarily took part in this research and the data was analyzed using factor analysis. We have also tried to study if there is a difference in the academic delivery and content in commerce and management stream.

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1. Introduction

The education sector in India is developing exponentially and has acquired the status of a service providing industry. New universities (real and virtual) have come up which has highly affected the demand and supply of students, resulting in forcing the institutes to think upon innovative ways to improve the service quality perceived by different stake holders as valuable. The challenges in Higher Education sector has increased greatly in recent times due to globalisation, technological advancement and increase in number of higher education institutes that offer skill-based learning. Furthermore, economic forces also impose pressure on the higher education institutes for cost cutting and indirectly suffering in quality. According to UNESCO data, India has one of the lowest public expenditure rates on education per student, compared to other Asian countries, which is inadequate for a country aspiring to create a pool of skilled works person to fuel our economic growth. Jobs in the real world have also become highly competitive as the employers can choose from a large number of potential applicants. According to the All India Survey on Higher Education (2016-17).

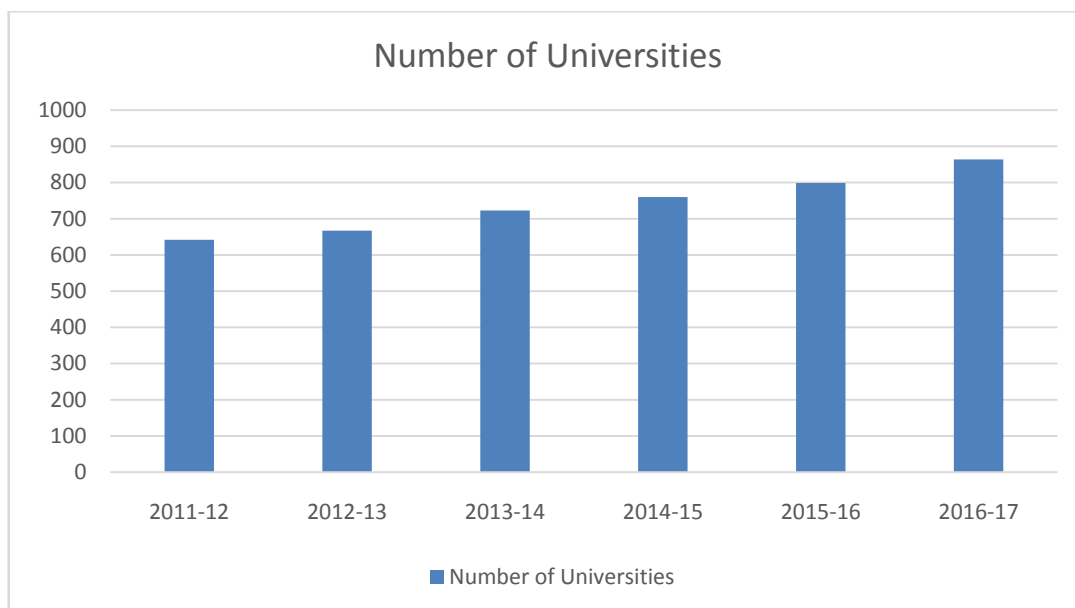
data, there is an approximate increase of 35% in the number of universities in India in the past 8 years Total enrolment in higher education has been estimated to be 35.7 million. About 79.4% of the students are enrolled in Undergraduate level program. 1,41,037 students are enrolled in Ph.D. that is less than 0.4% of the total student enrolment. On the other hand, second to Under Graduate, 11.2% students are enrolled in post-

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graduation which is approximately 40.0 lakh students. The student enrolment from UG to PG is thus decreasing steeply. Thus to improve and manage the quality of education, institutes need to work on different factors which needed to be updated and implemented in the quality measurement system (Sunder & Sunder, 2016)

Figure 1. Growth in number of universities in India. Source : AISHE



2. Six Sigma in Education

The Greek symbol σ (sigma) is a statistical term denoting “standard deviation” (S.D). S.D denotes how far the data points are from the mean, typically, and it may be computed with a formula. The phrase six sigma refers to several things: One, six sigma is a performance level - for a six sigma process, 6 standard deviations each may be fitted between the mean and the upper and lower specification limits. Six Sigma is used for improvement in the performance of a work process which is repetitive in nature. Education is also a continuous work process, including repetitive processes like Recruiting, Admission, Registration, Lectures, Examinations and finally Graduation. Factors influencing successful six sigma projects include management involvement and organizational commitment, project management and control skills, cultural change, and continuous training. Quality in higher education is treated from different perspectives in various articles and literature. According to Paval and Saebu (2014), characteristics of six sigma are compatible with ISO 9000, a quality management system and integrating six sigma in any higher education institute will be successful.

Application of DMAIC methodology (Design, Measure, Analyze, Improve & Control) is used in quality management. Attempts to establish a relationship between DMAIC methodology and its scope in the academic environment involving undergraduate engineering programs have been studied (Shoeibi & Zahmatdoost, 2015).

Six Sigma Define Phase :

The institute's purpose and scope are well defined in this phase. Here, the first step is to identify the various stakeholders. In the current study, we have identified the students as the primary stake holders for the quality assessment. For improving the performance, the students who attend the lectures in the classes can identify the problems .

Six Sigma Measure Phase :

A measure is a quantified value. This phase helps the institutes to rank the potential causes and also to identify the variables needed to be measured. The qualitative and quantitative data was collected from the primary stake holders and the direct recipient of the service i.e. the students. The data was collected in the form of questionnaire. The objective of the study was clearly mentioned in the questionnaire. Data was collected from students of basically commerce and management stream i.e. B Com, M.Com, B.B.A and M.B.A. The questionnaire was divided into three parts

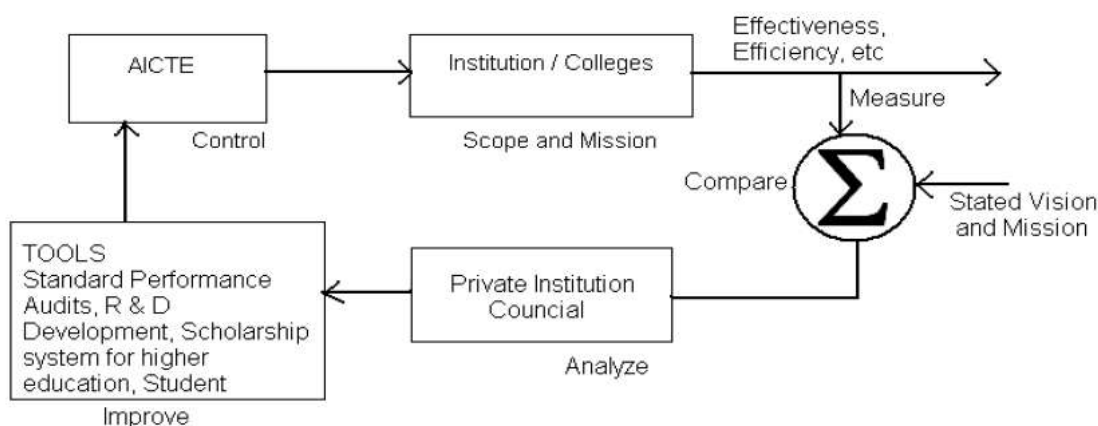
Part 1 : Comprised of the respondents demographic and academic background.

Part 2 : The respondents were asked to rate their level of agreement to each statements asked related to Academic Research.

Part 3 : Students were asked to comment about what more do they expect from their course.

Once the list of question was set, a pilot study of 40 students was conducted. After the survey, the questionnaire was submitted to academicians and language experts for feedback. Consequently, changes were done accordingly and at the end a total of 30 statements were drafted and that were grouped into 3 clusters Viz Cluster A : Self Motivation. Cluster B : Academic Research quality . Cluster C : Comment on the course. A total of 220 students from public and private Higher Education Institutes responded to the survey. The responses help to identify the degradation variables associated with the performances of the students.

Figure 2. Six Sigma Methodology in Educational Institutes.



Six Sigma Analyse Phase:

In this phase the collected data in the measure phase is to be examined to identify the root causes of the problem. To implement factor analysis to our sample, we have Kaiser Meyer Olkin (KMO) measure. The KMO statistic range is from 0 to 1, and it the value is over 0.6, the sample is fit for the factor analysis technique (Huck,2012; Pallant, 2011). In our Study, the KMO measure has a value of 0.934.

Table 1 : KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.934
Bartlett's Test of Sphericity: Approx. Chi Square	3402.211
df	315
Sig.	.000

Another test is Bartlett’s Test of Sphericity. It compares the correlation matrix with the identity matrix. It checks if there is a redundancy between variables that can be grouped with some factors. This is also a statistical test for the overall significance of all correlation within the correlation matrix. This test is important in order to check where PCA can be run on the given sample data. A p-value of less than 0.05 at 5% level of significance indicates significant correlation between the variables. In the current sample test, the p value is less than 0.05 which indicates that factor analysis using PCA can be performed on the given data. (Table 1.)

The variable’s commonality indicating the amount of variance in each variable was also assessed to ensure acceptable levels of explanation. The result stated that all the commonalities are more than 0.5 except one. (Table 2)

Table 2 : Communalities

Questions	Initial	Extraction
My learning increased through class room teaching	1	0.696
I made progress toward achieving course objectives	1	0.623
Learning to interpret primary texts or works.	1	0.603
Developing skill in critical thinking, problem solving through class lectures.	1	0.669
Developing skill in critical/analytical writing.	1	0.586
Developing the ability to work collaboratively with others.	1	0.612
Gaining an understanding of the relevance of the subject matter to real-world issues	1	0.584

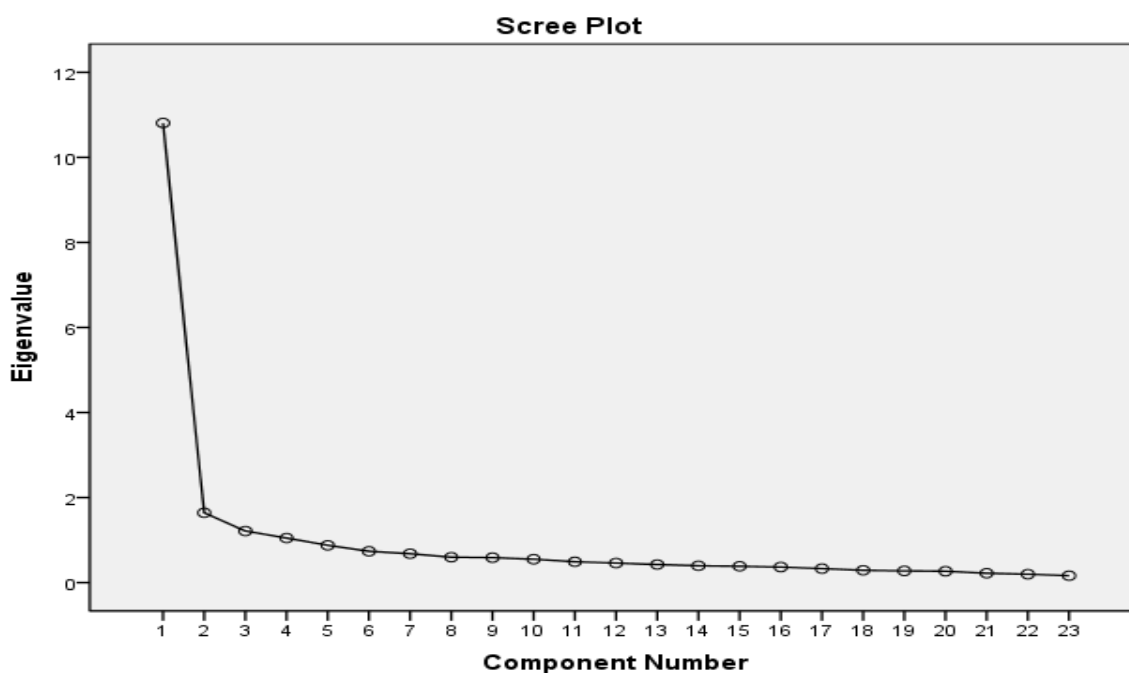
Gaining an understanding of different views and perspectives on the subject.	1	0.702
Gaining an understanding of the historical and social context in which the subject has developed.	1	0.645
Do you understand what is expected from you in the classroom participation?	1	0.597
Acquiring knowledge and skills applicable to a specific job or type of work (vocational preparation).	1	0.725
Acquiring background and specialization for further education in a professional, scientific, or scholarly field	1	0.732
Gaining a broad general education about different fields of knowledge	1	0.596
Thinking analytically and logically	1	0.669
Putting ideas together, seeing relationships, similarities, and differences between ideas	1	0.597
Learning on your own, pursuing ideas, and finding information you need.	1	0.678
Analyzing quantitative problems (understanding probabilities, proportions, etc.).	1	0.684
During the current year, to what extent has your coursework emphasized the following mental activities? Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	1	0.536
Analyzing the basic elements of an idea or theory such as examining a particular case or situation in depth.	1	0.583
Generating and organizing ideas, information, or experiences into new, more complex interpretations and relationships	1	0.564
Used a computer to produce visual displays of information (charts, graphs, spreadsheets, etc.).	1	0.742
Used a computer to analyze data (statistics, forecasting, etc.).	1	0.755
Applying theories or concepts to practical problems or in new situations	1	0.532

Principal component analysis with varimax rotation is used for factor analysis in this study (Table 3) The factors with an eigen value of 1 or more are considered. (Scree Plot)

Table 3. rotated Component Matrix

Code	Question	Component			
		1.	2	3	4
HB2	I made progress toward achieving course objectives	.741			
HB6	Developing skill in critical thinking, problem solving through class lectures.	.707			
HB8	Developing the ability to work collaboratively with others.	.681			
HB10	Gaining an understanding of different views and perspectives on the subject.	.680			
HB12	Do you understand what is expected from you in the classroom participation?	.675			
HB11	Gaining an understanding of the historical and social context in which the subject has developed.	.664			
HB5	Learning to interpret primary texts or works.	.651			
HB9	Gaining an understanding of the relevance of the subject matter to real-world issues	.628			
HB1	My learning increased through class room teaching	.613	.527		
HB7	Developing skill in critical/analytical writing.	.543			
HC7	Analyzing quantitative problems (understanding probabilities, proportions, etc.).		.716		
HC6	Learning on your own, pursuing ideas, and finding information you need.		.709		

HC4	Thinking analytically and logically		.607		.500
HC5	Putting ideas together, seeing relationships, similarities, and differences between ideas		.574		
HC9	Analyzing the basic elements of an idea or theory such as examining a particular case or situation in depth.		.535		
HC12	Used a computer to analyze data (statistics, forecasting, etc.).			.823	
HC11	Used a computer to produce visual displays of information (charts, graphs, spreadsheets, etc.).			.795	
HC13	Applying theories or concepts to practical problems or in new situations			.643	
HC10	Generating and organizing ideas, information, or experiences into new, more complex interpretations and relationships				
HC1	Acquiring knowledge and skills applicable to a specific job or type of work (vocational preparation).				.770
HC2	Acquiring background and specialization for further education in a professional, scientific, or scholarly field				.725
HC3	Gaining a broad general education about different fields of knowledge				.573



The factors identified as a part of factor analysis can be described as follows:

Factor 1 is labelled as Classroom Interaction and Participation and is represented by HB2, HB6, HB8, HB10, HB12, and HB11, in order of factor loadings ranging from 0.741 to 0.664. This latent variable or factor measures the quality of class lectures and interaction among students and faculty. This factor helps in understanding the whether the classroom teaching is helping the student in critical thinking, problem solving ability and team work..

Factor 2 is labelled as Encourage Research Based Learning and is represented by HC7, HC6, HC4 and HC 5 in order of factor loadings ranging from 0.716 to 0.574. This latent variable or factor measures whether students are able to think independently and are able to analyze problems analytically and logically. This factor helps in understanding how much emphasis is given on research based learning.

Factor 3 is labelled as Practical Application Using IT and is represented by variables HC12, HC 11 and HC 13 in order of factor loadings ranging from 0.823 to 0.643. This latent variables or factor measures the practical application of concepts learn and applying it using information technology and analytics. This factor helps in understanding whether students are using computer to learn the practical application of business concepts.

Factor 4 is labelled as Specialization and Vocational Skills and is represented by variables HC1, HC2 and HC3 in order of factor loadings ranging from 0.770 to 0.573. This latent variable measures the availability of vocational subjects which are industry specific and needs specialization. This will help in understanding the level of readiness educational institute have to produce industry ready graduates by offering vocational and specialized skill development course material.

Table 4 . Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.81	46.99	46.99	10.81	46.99	46.99	5.11	22.24	22.24
2	1.64	7.14	54.12	1.64	7.14	54.12	3.43	14.90	37.13
3	1.21	5.27	59.40	1.21	5.27	59.40	3.22	14.01	51.14
4	1.05	4.55	63.95	1.05	4.55	63.95	2.95	12.81	63.95
5	.88	3.81	67.77						
6	.74	3.20	70.97						
7	.68	2.95	73.92						
8	.60	2.60	76.51						
9	.59	2.55	79.06						
10	.55	2.39	81.46						
11	.49	2.13	83.59						
12	.46	2.00	85.59						
13	.43	1.85	87.44						
14	.40	1.72	89.16						
15	.38	1.67	90.83						
16	.37	1.59	92.42						
17	.33	1.43	93.84						
18	.29	1.27	95.11						
19	.28	1.20	96.31						
20	.27	1.16	97.47						
21	.22	.96	98.43						
22	.20	.86	99.29						
23	.16	.71	100.00						

Six Sigma Improve and Control Phase:

In the improvement phase, we have to identify the options for the solution of our problems. Implementation of the proposed changes are also of utmost importance. In this phase, the reasons for student's failure and lack of interest in the subject must be identified. Continuous evaluation, monitoring and counselling of the students will help them overcome their confusions and improve the quality of education. Identifying and understanding key factors, obstacles and shortcomings of an organisation make them better in taking constructive strategic decisions.

In the control phase, the knowledge so obtained can be used to accelerate the improvement of other areas. Colleges should think like corporates, re-engineer, innovate and diversify their structure continuously to provide optimum service. Service satisfaction evaluation should also be done on continuous basis.

Limitations and Future Research :

Successful implementation of Six Sigma methods have seen an exploding growth in the past years. We in this paper have tried to implement the DMAIC approach to the higher education. This study has focused on only

one of the stake holders of quality i.e. Students to measure the quality in higher education institutes. Further studies may include other stake holders like parents, teachers, administrators, government, etc. An educational institute is operational only for 10 months whereas a company works for 12 months and is more interested in the profits (outcome oriented). Moreover, Students are also partially responsible for their own learning, which can affect the problems of attaining six sigma greatly.

Also the data collected was cross-sectional, i.e. it was collected during one period of time, whereas the data can be collected at different points of time for further studies, to compare any changes in the satisfaction levels.

Conclusion

By The International Commission on Financing Global Education Opportunity, at current rates, by 2030, of the 1.4 billion school-age children in low- and middle-income countries, 420 million will not be on track to learn the most basic skills in childhood, and 825 million will not be on track to acquire the basic secondary-level skills they need to succeed in life, school and work. One billion young people will enter the workforce in the next decade. Six sigma plays a very important role in improving the efficiency and effectiveness of the institutes. In this paper we had studied DMACI approaches and different tools and techniques which can be used in improving the quality of education at different levels. Also we have identified some factors which can be used in measuring the effectiveness of academic research, Digital skills and the content. Higher education institutes in India should also start implementing six sigma methodologies for maintaining high academic standards and improving it continuously and develop problem based learning, case based learning and Internship. As academicians, we should try to understand six sigma better so that no over hype is created or we are too quick to dismiss it

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