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Exploring the Effect of Six Sigma Practices on Quality Improvement of Higher Education: An Exploratory Study

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Abstract

Quality assurance at the higher education level is the most important impacting factor on society and the economy. Six Sigma are key initiative for improving the quality of education in higher education institutions. The objectives of the present study were to explore the application of Six Sigma practices at the university level and determine the relationship between Six Sigma practices and quality assurance at the university level. In the present study, a quantitative research approach was applied to carry out the study. Three sampling regions, Upper, Central, and Southern Punjab of Punjab province were selected to carry out the study. Two public sector universities from each geographic region were selected. In the next stage, four disciplines of above mention universities were selected. A multi-stage random sampling technique was employed to collect data. Data were analyzed by applying SPSS's latest version, structural equation modeling, and regression analysis to analyze the data. The study's findings contribute to understanding the multifaceted nature of QA in university teaching. The proposed model exhibits strong explanatory power, predictive relevance, and goodness of fit. This research underscores the importance of various factors in enhancing quality assurance and informing educational practices and policies.

Keywords: Six Sigma, Quality Assurance, Higher Education, Structural Equation Modelling.

INTRODUCTION

Quality assurance at the higher education level has great importance because of its significant impact on society and the economy. A well-functioning quality assurance system guarantees that institutions and programs meet established standards and deliver high-quality education (Seyfried & Pohlenz, 2018). It enhances higher education institutions' credibility and reputation nationally and internationally (Steinhardt et al., 2017). Fostering a quality culture promotes continuous improvement and innovation in teaching, research, and infrastructure. It contributes to economic growth by producing a skilled workforce, attracting investment, and fostering technological advancements (Lim, 2018). A sustainable quality assurance program has various benefits, including enhancing employment opportunities, improving the education and training of future employees, nurturing future leaders, and facilitating a conducive learning environment, which enriches the academic and intellectual setting (Bi, 2022). Furthermore, a quality higher education system plays a decisive role in the successful development and functioning of an open democratic civil society, promoting social norms of communication and interaction, fostering philosophical thinking, and reasoning, and mitigating ethnic conflicts and gender or religious biases (Stephens, 2022). Quality assurance programs have several benefits that positively persuade individuals, institutions, and society. They enhance employment opportunities by ensuring graduates

possess the necessary market demands knowledge, skills, and competencies (Riad Shams & Belyaeva, 2019). Quality assurance is crucial for nurturing future leaders by ensuring that higher education institutions provide a supportive and advantageous learning environment (Idris, 2019). It supports the development of critical thinking, problem-solving, leadership, and communication skills among students (Kalpazidou Schmidt, 2017). A sustainable quality assurance program enriches the academic and intellectual landscape by fostering a culture of excellence and research (Wysocka et al., 2022). A quality higher education system promotes philosophical thinking and reasoning among individuals. It encourages students to question assumptions, analyze complex issues, and critically reflect (Kobets et al., 2021).

By fostering philosophical thinking, quality higher education institutions contribute to developing well-rounded individuals who can navigate a rapidly changing world (Turyahikayo, 2019). A successful Six Sigma project depends on management involvement, organizational commitment, project management, skills, cultural change, and continuous training. Understanding Six Sigma's key features, obstacles, and shortcomings allows organizations to support their strategic directions better and increase the effectiveness of coaching, mentoring, and training efforts. Effective Six Sigma principles practices and principles rely on the persistent refinement of the organizational culture. Organizations can successfully implement Six Sigma practices and drive continuous improvement by integrating statistical aspects with business perspectives.

Six Sigma

Six Sigma is considered another quality improvement fad by many C-suite executives. The Six Sigma methodology is a systematic and methodical approach to resolving issues in commercial procedures. The success or failure of a Six Sigma project depends on the appropriate use of the many tools and approaches that make up the Six Sigma methodology (Kalra & Kopargaonkar (2016). Six Sigma is a methodology for improving business processes that emphasizes using tried-and-true statistical tools and procedures (including statistical process control and the design of experiments) to cut down on defects (Pugna et al., 2016). Higher education is becoming a worldwide institution with issues due to resource restrictions. Higher education institutions are unique as the students, their parents, potential employers, and the general public have a vested interest in their success (Nadeau, 2017).

For Six Sigma methods to be successfully implemented in higher education, unique stakeholder needs and goals must be considered. Some people may view universities as non-profit institutions that exist solely to meet their communities' intellectual and societal requirements, in contrast to the commercial world (Sunder & Mahalingam, 2018). However, decisions in the academic world are not always based on hard evidence. Recordings of student answers on the ETS standardized test's accounting part are an example of a process improvement (Anthony & Antony, 2022). Additional information was gathered, including course assignments, texts, course structure, instructional strategies, and course sequence (Aghaei et al., 2023).

HYPOTHESIS

The following were the hypotheses of the study:

H_{01}. There is no significant relationship between Six Sigma practices and university quality assurance at the university level.

H_{02}. There is no significant relationship between the teaching approach and university quality assurance at the university level.

H_{03}. There is no significant relationship between evaluation methods and quality assurance at the university level.

H_{04}. There is no significant relationship between the teaching aids and quality assurance at the university level.

H_{05}. There is no significant relationship between teachers' attitudes and university-level quality assurance at the university level.

H_{06}. There is no significant relationship between teachers and administration coordination and quality assurance at the university level.

Research Design

The research was both co-relational and descriptive. As Malhotra and Dash (2011) stated descriptive research provides definitive results. It accomplishes every key learning goal associated with the topic at hand. The study used a descriptive research strategy and used statistical analysis to examine the hypotheses. In addition, the most recent version of clever PLS-SEM was employed for our exploratory analysis.

Sample

Through a multi-stage random sampling technique, two public sector universities were selected from each region of Punjab province. At the next stage, four departments from the aforementioned institution were chosen. The aforementioned justification of sample participants was established by the recommendations of Cohen et al. (2008), which state that if the population being studied is 100,000 or more, the sample size should not be less than 384.

Analysis of Data

After data collection, the quantitative method was used for data analysis. The most recent version of SPSS and smart PLS–SEM were used to conduct the statistical analysis. The structural equation model is a popular method of study in many fields. For the variance-based analysis, Ringle, Wende, and Will (2005) recommend using PLS-SEM. Hair, Sarstedt, Hopkins, and Kuppelwieser (2014) agreed that it enables researchers to simulate intricate connections between theoretical concepts.

$H_0$1: There is no significant relationship between Six Sigma practices and university quality assurance.

The model includes a constant term (2.371) with a standard error of 0.411. The coefficient for the Six Sigma variable indicates that for a one-unit increase in Six Sigma practices, there is an estimated increase of 0.223 units in university quality assurance, with a standard error of 0.212. The t-ratio of 1.371 suggests that the coefficient is statistically significant ($p < 0.05$), indicating a positive impact of Six Sigma practices on quality assurance.

Table 1.
Regression analysis of Six Sigma practices and university quality assurance

	Model	Parameters	Standard Error	t-ratio	Sig	R^2
Six Sigma	Constant	2.371	0.411	3.814	0.000	0.119
	QA	0.223	0.212	1.371	0.000	0.264

The constant term is also significant (t-ratio = 3.814), suggesting that even when Six Sigma practices are zero, there is a positive baseline level of quality assurance. The overall model's R-squared value of 0.264 indicates that approximately 26.4% of the variability in university quality assurance can be explained by Six Sigma practices. Therefore, the null hypothesis of no relationship between Six Sigma practices and university quality assurance is rejected, as both coefficients are statistically significant, affirming a significant positive influence of Six Sigma practices on quality assurance.

$H_0$2: There is no significant relationship between the teaching approach and university quality assurance.

Table 2.
Regression analysis of teaching approach and university quality assurance

	Model	Parameters	Standard Error	t-ratio	Sig	R^2
Teaching	Constant	3.234	0.241	4.475	0.000	0.194
Approach	QA	0.324	0.138	5.891	0.000	0.237

The regression analysis examined the relationship between the Teaching Approach and University Quality Assurance (QA). The model's goodness of fit was indicated by an R-squared value of 0.194, implying that approximately 19.4% of the variability in the Teaching Approach could be explained by University Quality Assurance. Both the constant term and the coefficient of QA were statistically significant ($p < 0.001$), with t-ratios of 4.475 and 5.891, respectively. As the p-values were well below the significance threshold ($a = 0.05$), the null hypothesis of no relationship between the Teaching Approach and QA was convincingly rejected. The positive coefficient (0.324) of QA suggests that as University Quality Assurance increases, the Teaching Approach also tends to improve.

$H_0$3: There is no significant relationship between evaluation methods and quality assurance at the university level.

Table 3.
Regression Analysis of and quality assurance

	Model	Parameters	Standard Error	t-ratio	Sig	R^2
Evaluation	Constant	3.120	0.514	5.367	0.000	0.164
methods	QA	2.017	0.381	3.419	0.000	0.281

The regression analysis examines the relationship between Evaluation Methods and Quality Assurance (QA) in the context of university-level teaching. The analysis includes a constant term, estimated at 3.120 with a standard error of 0.514, and a coefficient for QA, estimated at 2.017 with a standard error of 0.381. The t-ratio values for both the constant (5.367) and QA coefficient (3.419) are substantial, and the associated significance levels are both extremely low ($p < 0.001$). This indicates strong evidence against the null hypothesis for both parameters, implying that both the constant term and

QA coefficient significantly contribute to the model. The R-squared value of 0.281 suggests that about 28.1% of the variation in Evaluation Methods can be explained by the included variables. Therefore, the null hypothesis is rejected, emphasizing the meaningful impact of QA on Evaluation Methods in university-level teaching.

$H_0$4: There is no significant relationship between the availability of teaching aids and quality assurance at the university level.

Table 4.
Regression Analysis of teaching aids and quality assurance

	Model	Parameters	Standard Error	t-ratio	Sig	R^2
Teaching aids	Constant	2.331	0.521	5.667	0.000	0.119
	QA	1.227	0.267	3.541	0.000	0.228

The regression analysis examines the relationship between Teaching Aids and Quality Assurance (QA) in the context of university-level teaching. The model includes a constant term and the coefficient for QA. The results indicate that both the constant term (2.331) and the coefficient for QA (1.227) are statistically significant, with t-ratios of 5.667 and 3.541 respectively, both having p-values of 0.000. This suggests that the null hypothesis of no relationship between Teaching Aids and Quality Assurance is firmly rejected. The coefficients imply that, on average, for each unit increase in QA, the predicted score for Teaching Aids increases by 1.227. The model's R-squared value of 0.228 indicates that approximately 22.8% of the variability in Teaching Aids can be explained by variations in Quality Assurance. In conclusion, the analysis provides strong evidence that Quality Assurance significantly impacts the perceived effectiveness of Teaching Aids in university-level teaching.

$H_0$5: There is no significant relationship between teachers' attitudes and university-level quality assurance.

Table 5.
Regression Analysis of teachers' attitudes and quality assurance

	Model	Parameters	Standard Error	t-ratio	Sig	R^2
Teachers' attitudes	Constant	2.289	0.631	8.664	0.000	0.223
	QA	1.357	0.223	47.397	0.000	0.311

The regression analysis examines the relationship between teachers' attitudes and quality assurance (QA). The analysis reveals that both the constant term (2.289) and the coefficient for QA (1.357) are statistically significant, as indicated by their low standard errors, high t-ratios (8.664 for the constant and 47.397 for QA), and very low p-values (0.000). With a coefficient of determination (R2) value of 0.311, around 31.1% of the variance in teachers' attitudes can be explained by the variation in quality assurance. The null hypothesis that there is no relationship between teachers' attitudes and quality assurance is decisively rejected, given the extremely low p-value.

$H_0$6: There is no significant relationship between teachers and administration coordination and quality assurance at the university level.

Table 6.
Regression Analysis of teachers and administration coordination and quality assurance

	Model	Parameters	Standard Error	t-ratio	Sig	R^2
Coordination	Constant	2.002	0.361	5.367	0.000	0.116
	QA	1.301	0.116	3.512	0.000	0.265

The regression analysis aimed to examine the relationship between coordination between teachers and administration and quality assurance. The null hypothesis, which posits no significant relationship between the two variables, is decisively rejected. The results reveal that both the constant term (2.002) and the coefficient for coordination (1.301) are statistically significant, with p-values of 0.000, well below the conventional significance level of 0.05. The t-ratios of 5.367 for the constant and 3.512 for the coordination coefficient further confirm their significance. The model's R-squared value of 0.265 indicates that approximately 26.5% of the variation in quality assurance can be explained by the coordination between teachers and administration.

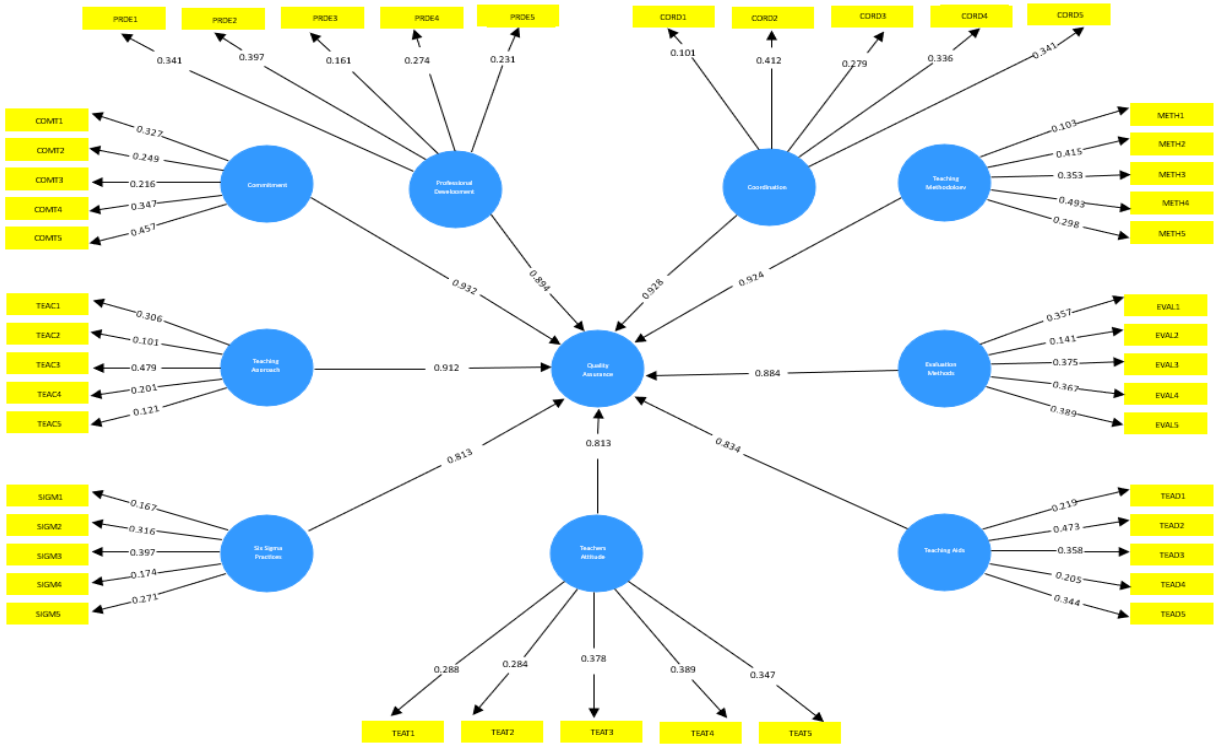

Figure1.
Structural Model

DISCUSSION

The positive perceptions of quality assurance, teaching approach, Six Sigma practices, evaluation methods, teaching aids, teachers' attitudes, coordination, and commitment align with previous research emphasizing the importance of these factors in enhancing educational quality. This study shows that students acknowledge the impact of teaching approaches on the quality of education they receive. Research conducted by Johnson

and Johnson (2014) supports that effective teaching approaches positively influence student learning outcomes. Innovative teaching methods have been shown to enhance student engagement and motivation (Smith et al., 2018). Weimer (2013) emphasized that student-centered teaching promotes active learning and caters to individual student needs, leading to improved educational outcomes.

RECOMMENDATIONS

Based on the results obtained from the analysis the following recommendations can be made to improve teaching quality and enhance the overall educational experience:

- Encourage teachers to employ various methods to cater to diverse learning styles and engage students effectively. Providing professional development opportunities focused on innovative teaching techniques can help teachers expand their pedagogical repertoire.

- Invest in up-to-date teaching aids and resources that align well with the subject matter and enhance the learning experience. Regularly assess the adequacy and relevance of teaching aids, seeking feedback from students and teachers to ensure their effectiveness.

- Create platforms and opportunities for teachers to collaborate, share best practices, and learn from each other. Encouraging interdisciplinary collaboration and organizing workshops or conferences can facilitate knowledge exchange and promote a culture of collaboration among teachers.

- Foster effective communication and coordination between teachers and administration. Ensure that teachers' needs and concerns are addressed promptly, and provide necessary resources and tools to support their teaching efforts.

- Offer comprehensive and ongoing professional development programs that address the specific needs of teachers. These programs should focus on enhancing teaching skills, integrating technology into instruction, and staying updated with the latest educational research and best practices.

- Create a positive, inclusive work environment that values and supports teachers. Promote a culture of appreciation, recognition, and reward for teachers' commitment and efforts in their job responsibilities.

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