Information Sciences Letters
An International Journal

http://dx.doi.org/10.18576/isl/140103

A Lean Six Sigma Approach to Identifying Key Drivers of Academic Performance at Saad Al-Abdullah Academy in Kuwait

Rashed M. F. Al-Therwah[1,2,*], *Mahmoud El-Sharief*[2], *Ibrahim Mohamed Hassab-Allah*[2] *and Mahmoud Heshmat*[2]

[1] Ministry of Interior, Kuwait
[2] Department of Mechanical Design and Production Engineering, Assiut University, Egypt

Received: 18 Jul. 2024, Revised: 25 Sep. 2024, Accepted: 30 Nov. 2024
Published online: 1 Jan. 2025

Abstract: Through performance development and continuous improvement, educational institutions aim to accomplish their objectives efficiently and effectively. This study offers valuable insights for managing educational institutions, with a focus on contemporary management strategies. The study examines the benefits of applying Lean Six Sigma to enhance students' academic performance at Saad Al-Abdullah Academy in Kuwait. It focuses on factors that impact cadets' performance. To gather information on quality drivers about the following elements believed to affect academic performance, a survey was distributed to teachers and students: System, Vision and Mission, Curriculum Design and Alignment, Academic Environment, Student Personality-Related Factors, Teacher-Related Factors, and Teaching Methods and Approaches. All the identified criteria were covered by the questions included in the questionnaire. The findings were analyzed using the Six Sigma methodology (DMAIC) to identify the most important elements. The following important quality factors were determined to have the biggest effects on academic achievement based on the input that was collected and analyzed using the Pareto Chart for both teachers and students: Student Personality-Related Factors (active classroom participation improves performance, teacher quality and competence are critical to student success, and cultivating a growth mindset boosts student abilities through effort and practice), Academy System (the Academy's overall goals motivate high performance), Curriculum Design and Alignment (repetition in course content), and Teacher-Related Factors (expertise, pedagogical skills, and the ability to create a positive classroom environment significantly influence student achievement).

Keywords: Lean Six Sigma, Academic Performance, Educational Quality, DMAIC Methodology, Saad Al-Abdullah Academy, Continuous Improvement

1 Introduction

Education is the cornerstone of progress and an essential pillar of national advancement when it is carried out effectively. The success of educational institutions, particularly those with large student populations, is hindered by several problems and obstacles, as recent research has revealed. These problems could jeopardize the institution's seamless operation and lead to unsatisfactory student outcomes if not promptly remedied [1].

Despite challenges like increased competition and limited resources, educational institutions strive to achieve their goals effectively and efficiently by consistently improving their performance. A stronger focus on quality, growth, and achieving the highest performance standards is essential given the worldwide changes impacting the world today. Only if educational institutions recognize that performance quality is the path to long-term improvement and evolution will they be able to continue to play a significant and effective role in addressing these difficulties [2].

Furthermore, the importance of evaluating the performance of educational institutions has increased in tandem with society's growing external monitoring and accountability systems. This economic approach aims to assess the outcomes of the educational process by defining objectives, roles, selecting inputs, assessing outputs, and ensuring effectiveness. Goals and policies are thus established to demonstrate that programs and methods are effective and valid, ultimately ensuring the quality of outcomes.

* Corresponding author e-mail: r.altherwah@gmail.com

The current study aims to explore the benefits of applying Lean Six Sigma to enhance academic achievement among students at Saad Al-Abdullah Academy in Kuwait. The specific goal of the study is to identify the factors that influence students' achievement. Due to this, this paper is a crucial tool for managing educational institutions.

2 Related works

The Six Sigma approach has experienced a surge in effective implementation and heightened corporate interest in recent years. In practically any industry, from manufacturing to education, quality improvement can be achieved with the help of the DMAIC model, in particular, and the Six Sigma quality improvement mindset. Previous studies and research, conducted more than ten years ago, concluded that if organizations understood the essential characteristics, obstacles, components, and weaknesses of Six-Sigma methods, they could support their strategic directions and meet the increasing demand for coaching, supervision, and training [3]. This essay examines the evolutionary assessment of the benefits and challenges associated with Six-Sigma projects, highlighting the crucial elements necessary for successful Six-Sigma methodology implementation.

To improve student performance in three key subjects—math, Arabic, and English—a private secondary school in the Middle East employs Six Sigma [4]. The Six Sigma methodology of Define, Measure, Analyze, Improve, and Control (DMAIC) was the primary instrument for improving student performance, along with the Fishbone diagram, Pareto charts, and Critical-to-Quality (CTQ) tree.

To apply the Six-Sigma approach and gain a competitive edge at Saudi universities, one study employed the PRISMA 2015 inclusion and exclusion framework to select data from the Scopus database [5]. It was found that Saudi Arabian universities are focusing on developing their teaching structures and methodologies by utilizing the Lean Six-Sigma approach and the Six-Sigma methodology. According to the study's findings, the need to raise educational standards affects managers, instructors, employers, students, and every other aspect of higher education.

Applying Lean and Six Sigma approaches can also help school business leaders address several issues, including error-prone processes, wasteful supply utilization, and time-consuming, tedious procedures [6]. This analysis not only identified the district's opportunities but also estimated the cost of the problem and identified prevalent waste sources using Lean analytics. In addition to helping district leaders determine the financial and performance impact on the district and education, this provided them with full transparency into every aspect of the district.

To understand the evolution, benefits, and challenges of 6σ practices in academia, a study was conducted at Presidency University in Bangalore, Karnataka, India [7]. The study aimed to continuously reduce defects to enhance and optimize an organization's services, products, and processes. Using the DMAIC technique, the study identifies and understands the causes, then attempts to change them to provide the students with more academic and placement opportunities. Divergent backgrounds, mentalities, teaching philosophies, and social and environmental concerns are some of the factors that have been demonstrated to contribute to pupils' subpar performance.

In a similar vein, [8] integrated Discrete Event Simulation (DES) and Adaptive Neuro-Fuzzy Inference System (ANFIS) to examine and enhance a cement bag production system. ANFIS maps and forecasts the production rate depending on important elements, whereas DES measures Key Performance Indicators (KPIs). [9] applied lean Six Sigma methodologies, including statistical process control (SPC), process capability measurements, and analysis of variance (ANOVA), in a case study to enhance quality and reduce defects in a cement bag company. To determine the best working conditions, these methods employ regression analysis to identify and mitigate production variations, as well as address issues caused by inadequate supervision. The methodology shows that a 2.5% increase in output rate is achievable using a real production line. Similar to this, [10] concluded that ARENA software would significantly increase the efficacy of the Academy's actual enrollment system after using simulation to analyze a case study of the Saad Al-Abdullah Academy for Security Sciences' new student registration procedure in Kuwait.

A study on "Applying Six-Sigma in higher education quality improvement" [11] examined the effects of Six Sigma tools, such as SPC, FMEA, and Lean, on educational quality. Because there is a wealth of data available, including trends in student enrollment, graduation rates, CGPA rates, and retention rates, SPC is the primary tool used in academia. Following the identification of issues, a DMAIC-developed and presented solution resulted in improved, long-lasting procedures inside the organization, as well as increased student satisfaction and success rates, including graduation and retention rates.

Parallel to this, another study provides a thorough grasp of Six Sigma tools that may be used to enhance student performance using the DMAIC technique [12]. The study utilizes MATLAB tools, Graphical User Interface (GUI), SIPOC, and a survey questionnaire for Students. The MATLAB-generated graph displayed the outcomes of the stakeholders' scores. The Pareto chart, which uses a line and bar graph, is used to identify the 20% of the system that is responsible for 80% of the errors. The graph created using the scores provided by various stakeholders (students, instructors, etc.) identifies areas that need improvement.

The importance of faculty members was also mentioned in the report. To achieve academic excellence, the author reviews the application of Lean Six-Sigma Implementation in Engineering Institutions and outlines several critical to quality (CTQs) parameters, such as the percentage of students who complete the syllabus, the percentage of students who graduate, the percentage of students who receive distinction, and the student success rate in exams [13].

A research study on the impact of Lean Six Sigma on improving higher education systems was conducted by Allameh Tabatabai University in Tehran, Iran, which was handling a high volume of student complaints regarding advising and student services. During the measure phase, a survey method was combined with Six Sigma tools. To further understand the low satisfaction ratings, the LSS team conducted a student focus group in response to the findings [14].

3 Why Six-Sigma in Education?

Although Six Sigma was first developed for industrial processes, it has been successfully applied to improve quality and productivity in various sectors, including higher education [15]. However, it's common knowledge that the education sector has unanticipated elements, such as human factors, which often don't align well with statistically based and regulated methods like 6σ. As a result, the 6σ approach is only applicable to a limited range of academic subjects. The education sector's areas best suited for the application of 6σ are academics and student performance, administration, admissions, and enrollment [4].

Higher education institutions can improve student academic performance by implementing Six Sigma approaches. The approach's emphasis on reducing errors and unpredictability aligns well with improving student performance. Institutions can methodically identify and address problems influencing student outcomes by applying Six Sigma's DMAIC design [16].

In conclusion, implementing Six-Sigma to enhance classroom performance can lead to significant improvements in learning outcomes. Through the adoption of the methodology's data-driven approach and principles of continuous improvement, academic institutions can identify crucial elements influencing student achievement, implement targeted interventions, and evaluate their effectiveness. According to [17], this strategy aligns well with the growing emphasis on academic analytics and data-driven decision-making in higher education, potentially enhancing student performance, retention, and overall institutional success.

4 Methodology

There are two basic methods for implementing Six Sigma in companies. The original and most widely used model is called DMAIC. It stands for the definition, measurement, analysis, improvement, and control of the five basic application processes. This approach is used when a company needs to develop and enhance its products or services to better meet the needs of its clientele. The five basic application stages—define, measure, analyze, design, and verify—are represented by the second model, DMADV. This approach is used when a company needs to develop a new process, product, or service that doesn't already exist.

Figure 1 illustrates the DMAIC, a systematic methodology for problem identification and resolution used by Lean. Each step of the process is described below. Every stage uses key performance indicators (KPIs), which range from a large number to a crucial handful. These few indicators are the cause of the performance discrepancy or issue. Given the nature of the research challenge, the DMAIC technique of the Lean Six-Sigma approach is the primary methodology used in this study.

1. **Define stage**: This phase focuses on establishing the objectives of improvement initiatives, determining which processes require change in light of consumer demands and expectations, and articulating these objectives in the form of quantifiable targets. The goal of this stage is to confirm that the chosen process or issue for improvement aligns with the organization's priorities and has management support. The define stage starts with the problem's definition and concludes with a comprehensive grasp of its boundaries.
2. **Measurement stage**: By gathering fundamental data and information on the process identified in the previous stage, this step aims to measure the current level of performance. This data is utilized to provide a more precise picture of what is happening in the process and to gain a better understanding of customer expectations, which is where the issue resides. The first step in the measurement stage is gathering the required information and turning every aspect of the issue into a quantitative form that can be quantified, such as the frequency with which the process falls short of meeting the Critical-To-Quality requirements that customers require.
3. **Analyze stage**: The goal of this stage is to gain a better understanding of the actual causes of errors or defects. To achieve this, the data and the process itself are analyzed to determine the underlying factors that contributed to the current Sigma level of performance, as well as the shortcomings and deviations from the standards. Additionally,

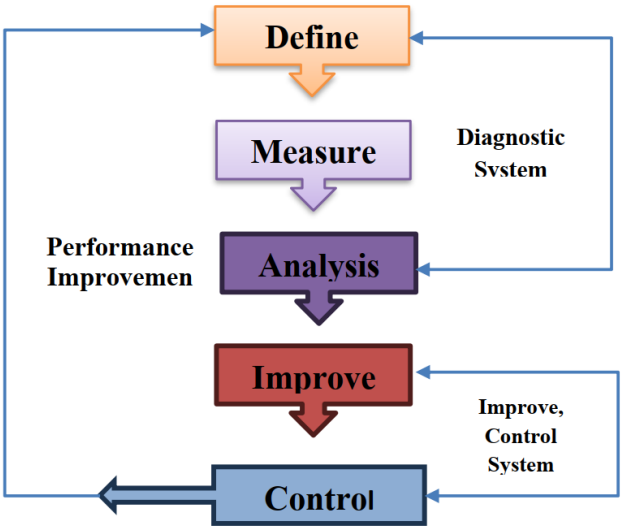

Fig. 1: The DMAIC Process and Filter.

methods for reducing or eliminating the gap between the process's current performance and the expected or desired performance are identified through statistical analysis of the variables that affect the output quality. Finally, a plan is developed to address the priorities for future improvement.

4. **Improvement phase**: This stage involves identifying and addressing ways to reduce the levels of defects (deviations), which may require multiple rounds of improvement processes utilizing planning and management tools to develop creative alternatives for development.
5. **Control stage:** At this point, the control technique is chosen and implemented for the new process, if feasible. By altering rules, procedures, and management systems, a system is created to sustain the intended improvements, prevent the issue from recurring, and continue implementing the new system within the institutional setting. Generally speaking, this entails two primary steps: establishing a response strategy and specifying the technological mechanism of control.

Based on what has been previously said, this part of the study aims to explore the benefits of using the Lean Six-Sigma approach in improving the Kuwait Police Academy's performance.

5 Case Study

One of the military colleges in the State of Kuwait is the Police College, also known as the Saad Al-Abdullah Academy for Security Sciences. It is associated with the Ministry of Interior of Kuwait. Originally founded in 1956 as the Police Personnel School, the academy underwent several successive stages of development. It was the organization responsible for training and credentialing the Ministry of Interior's connected police forces. [1]

Using the Six-Sigma methodology, which is regarded as a novel strategy to increase the quality levels of processes and lower error rates in these processes, the current study aims to improve and enhance university performance at the academy. As a result, performance in educational institutions becomes more efficient and reaches its optimal level. As a result, this raises a significant question regarding the future of academic performance evaluation philosophy. How can the Six-Sigma methodology be applied to assess and improve their performance?

5.1 Define Phase

DMAIC begins with the identification and definition of the problem statement. The goal of the 'Define' phase is to define the project goals and customer deliverables.

[1] $https://www.dirasaabroad.com/saad-al-abdullah-academy-for-security-sciences/$

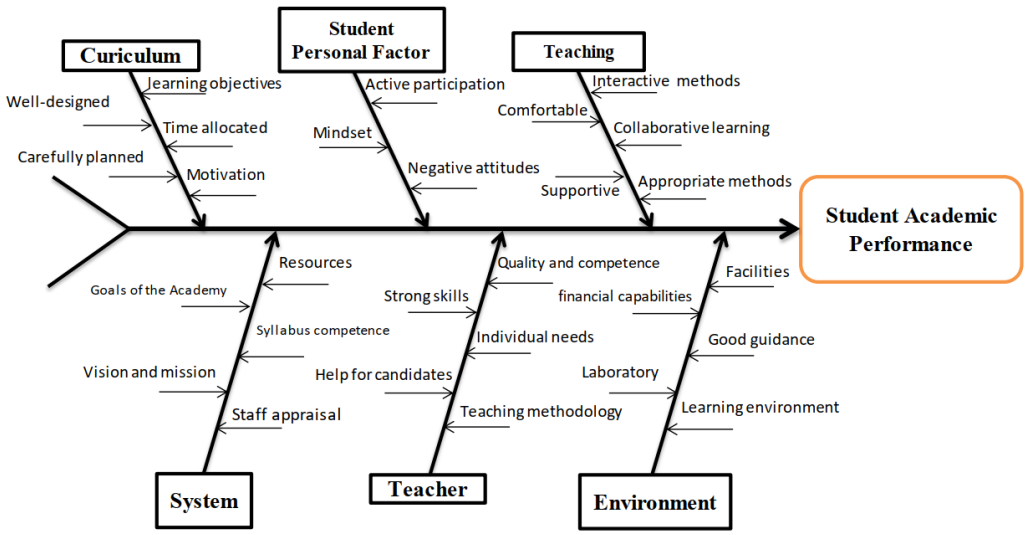

Fig. 2: Fishbone diagram for factors affecting students' academic performance.

The Academy students' academic performance is taken into account. The most important factor in a student's academic career is their grade point average (GPA). When applying for master's and doctorate programs or training scholarships, GPA is frequently a crucial factor. This portion of the research increases the student's eligibility for higher academic grades. 6σ techniques are used to analyze academic performance data and increase the number of students eligible for further study. What elements influence students' academic achievement is the primary query.

Therefore, the primary objectives are to enhance the cumulative GPA of students at the academy, to identify the influencing factors and the degree of influence each factor has on students' performance in the academy, and to establish a measurement system for indicators and data.

5.2 Measure Phase

The majority of numerical research and data analysis occurs during this stage. We focus on identifying the underlying causes of the issue and validating the measurement system. The Measure Phase's objectives are to create a plan for gathering data and pertinent information, validate the measurement system, and assess the process's capabilities.

5.3 Analysis Phase

Critical analysis is conducted at this phase using Six-Sigma methodologies, such as the Pareto diagram and the Fishbone diagram, also known as the Cause-and-Effect diagram. After discussions with academic staff and management to understand the causal relationships, a fishbone diagram was used to finalize the identification of the causes influencing academic accomplishment as shown in Figure 2.

To determine the factors that affect students' academic GPAs, a "fishbone diagram" is utilized. These elements include the academy's structure, academic programs, learning environment, individual challenges, and other aspects related to the academic community. It is expected that improving and expanding these components will impact the academic performance.

5.4 Data Collection Plan

The following is a sample size: 66 pupils and 33 teachers were selected for the project, using a random sampling technique. Because the elements above are inherently human, they may not be quantifiable. Therefore, the only option to measure them is to survey a sample of students, asking them to rate the reasons they believe are important on a scale of 1 to 5.

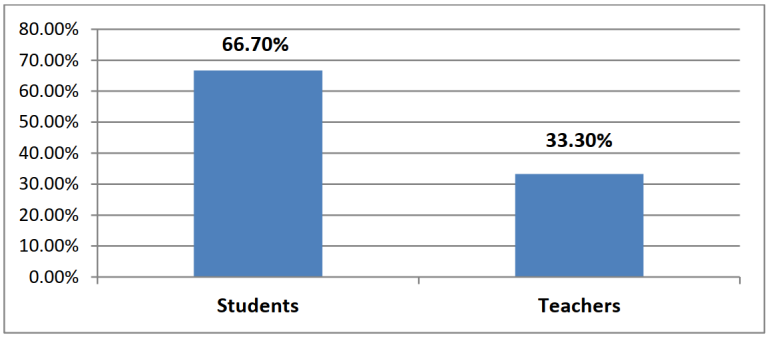

Fig. 3: Sampling size.

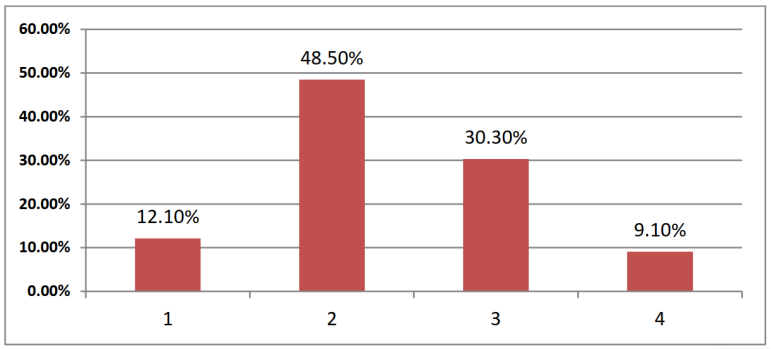

Fig. 4: Student sample by study year.

A questionnaire form was created with questions about all the factors identified. The results of the questionnaire were then examined using the Six Sigma and DMAIC methodologies (definition, measurement, analysis, improvement, and control). By identifying the most significant influencing factors, the majority of the problem's causes can be addressed by controlling those factors.

The following factors were considered to have an impact on academic performance: System, Vision and Mission, Curriculum Design and Alignment, Academic Environment, Student Personality-Related Factors, Teacher-Related Factors, and Teaching Methods and Approaches. To gather information on quality drivers, a survey was given to teachers and students (see Appendix 1).

5.5 Survey Results

1. **Sample Size**
   Students comprise approximately 67% of the sample as a whole, whereas teachers make up roughly 33%, as illustrated in Figure 3. Additionally, as Figure 4 illustrates, the bulk of the sampled students are in their second and third years of study, with second-year students comprising roughly 48.5% of the overall sampled student body and third-year students accounting for 30.3%.
2. **Pareto Diagrams**
   To condense the numerous components into a manageable yet significant figure, a Pareto chart is utilized. The trend line and the cumulative percentage contribution of the explanations displayed in the Fishbone Diagram are illustrated using a Pareto chart, a unique type of histogram. It operates according to the Pareto principle, also known as the 80/20 rule. "For many events, about 80% of the effects come from 20% of the causes," it says.
   As said before, the reasons need to be quantifiable to produce a Pareto chart or diagram. The only way to measure the factors indicated in the Fishbone is to conduct a survey, as they are human variables. As a result, it was decided to

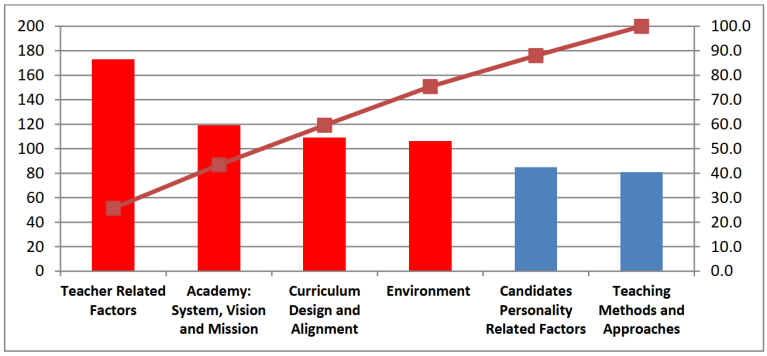

Fig. 5: Pareto Chart of Teacher Survey Results (on main axes).

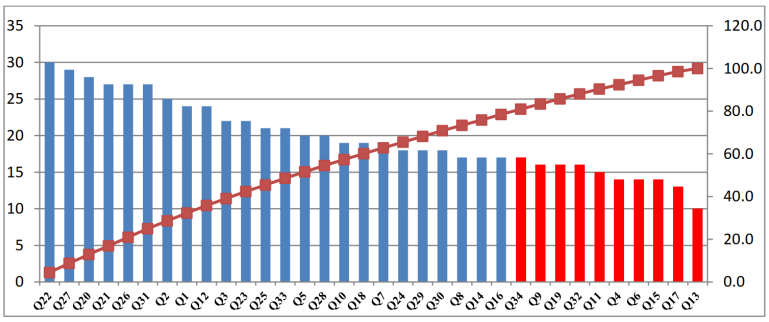

Fig. 6: Pareto Chart of Teacher Survey Results (on factors).

poll the students by asking them about the causes and to rank the factors from 1 to 5 in terms of their relevance. The responses were used to construct the Pareto chart that is shown below.

(a)**Teacher response**

According to the Pareto chart in Figure 5, which shows the Six-Sigma major axes that influence students' academic performance from the teacher's perspective, four of these axes account for 80% of the issue. These factors fall under the categories of the Fishbone: environment, curriculum design and alignment, teacher-related factors, and academic system. If we address these causes, the majority of the problem's causes will be resolved.

Furthermore, teachers strongly agreed that many factors affect student officers' academic performance. These include the following Six-Sigma factors as shown in Figure 6: (1) Positive interactions in the classroom help students perform better academically; (2) Teachers' quality and competence play a crucial role in student officers' academic achievement; (3) Negative attitudes and fear of failure can lower student officers' self-confidence; (4) Promoting a growth mindset increases student officers' capabilities through effort and practical practice; (5) Teachers' poor teaching skills affect officer students' performance; and (6) Teachers employ traditional teaching methods that heavily rely on lectures and memorization. Additionally, teachers agree that the academy's educational system is a key factor in determining the academy's goals.

(b)**Student response**

However, from the students' perspective, the Student Pareto chart in Figure 7 indicates that the four primary axes that teachers agreed were influencing students' academic performance are also responsible for 80% of the issues. Their priorities, however, differ slightly because they fall under the categories of teacher-related factors, academic system, environment, and curriculum design and alignment.

Additionally, students strongly agreed on the following important factors as shown in Figure 8:

i. The quality and competence of teachers play a pivotal role in student officers' academic achievement;
ii. Negative attitudes and fear of failure can reduce student officers' self-confidence;
iii. Encouraging a growth mindset increases student officers' capabilities through effort and practical practice;
iv. Positive classroom interactions contribute to improving student officers' academic performance;
v. Poor teacher teaching skills affect officer students' performance;

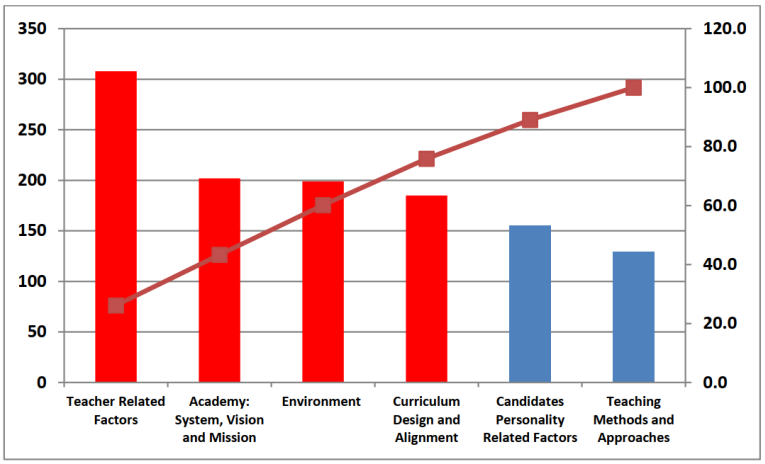

Fig. 7: Pareto Chart of Student Survey Results (on main axes.

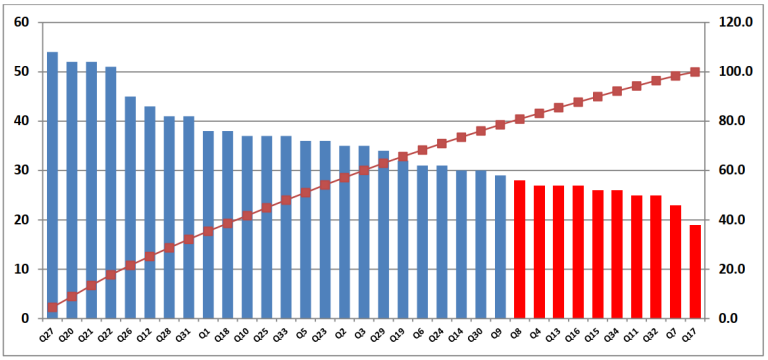

Fig. 8: Pareto Chart of Student Survey Results (on factors).

vi. Academic curricula for officer cadets contain repetition of topics and need to be updated and reviewed.
vii. Academy teachers have strong content knowledge, pedagogical skills, and the ability to create a positive environment in the educational process, and
viii. Teachers use traditional teaching methods that rely heavily on lectures and memorization.

6 Discussion

Based on the documented experiences of institutions attempting to apply Lean Six Sigma approaches to enhance the overall quality of student education or the effectiveness of their administrative procedures, it is reasonable to believe that this strategy is still relatively new in academia. Only a small number of cases have measurable outcomes, and the university system as a whole has yet to adopt it. Universities are complex socio-technical systems where different processes, aims, and priorities interact in dynamic, non-linear, and often synergistic ways. Expectations of numerous parties must be taken into consideration, and uncertainties affect the results [18].

Like any other business, a university must contend with uncertainty and ongoing change at an ever-increasing rate. It needs to equip itself with powerful tools so that it can operate in a hazardous environment and remain adaptable when faced with uncertainty. In this era of increasing rivalry and resource scarcity, the only institutions likely to gain a competitive edge are those that have the means to differentiate themselves [2]. Will lean Six Sigma methods be enough to sustain these advantages over time? The currently available conclusive results are limited.

Current research supports the notion that the DMAIC model and increased organizational interest are effective tools for achieving quality improvement in education, with Fishbone diagrams and Pareto charts serving as the primary tools for

identifying the key factors that influence student academic achievement [3]. For instance, it can aid in enhancing student academic achievement [2]. According to [5], the study concluded that improving educational quality has an impact on all aspects of university education, including students, employers, professors, and managers.

Furthermore, several variables associated with students' poor performance align with previous studies. In [7], which address issues such as the organization's vision and mission, social concerns, teachers' educational philosophies, and environmental considerations. Recent research has demonstrated that faculty members play a crucial role in achieving academic success [13], [14].

7 Conclusion

In conclusion, this study has provided valuable insight into the key factors influencing academic achievement at Kuwait's police academy. By examining teacher and student input, we identified significant quality drivers that significantly impact student outcomes. Based on feedback collected in earlier phases and analyzed using a Pareto Chart for both teachers and students, the following primary quality variables have the greatest impact on students' academic progress:

1. **Academy System:** The overall goals of the Academy motivate high performance.
2. **Curriculum Design and Alignment**: There is repetition in course content.
3. **Student Personality Factors**: Active class participation enhances performance. The quality and competence of teachers are crucial to students' academic success, and fostering a growth mindset helps students improve through effort and practice.
4. **Teacher-Related Factors**: The competence of teachers plays a vital role in student achievement. Teachers at the Academy possess strong content knowledge, pedagogical skills, and the ability to foster a positive classroom environment.

Ultimately, it's essential to acknowledge the limitations of the research. The study employs Six Sigma at a Kuwaiti police school; however, the latter two Six Sigma stages could not be implemented due to administrative and security constraints.

References

[1] R. Al-Khani, *Administrative Problems in Educational Institutions*, Al-Alukah, 2016. (In Arabic). Available: https://www.alukah.net

[2] N. S. Khalil, *Modern Approaches to the Management of Educational Institutions*, Dar Al-Fajr, Cairo, Egypt, 2015. (In Arabic)

[3] J. Mehrabi, "Application of Six-Sigma in educational quality management," *Procedia - Social and Behavioral Sciences*, vol. 47, pp. 1358–1362, 2012.

[4] M. Arafeha, M. Khadera, T. F. Desouky, N. Azzama, and A. Aljundia, "Six Sigma application for improving student academic achievement," *Management Science Letters*, vol. 11, pp. 699–710, 2021.

[5] S. A. Al-Otaibi, "Implementation of Six-Sigma Methodology to Achieve a Competitive Edge in Saudi Universities," *Studies of Applied Economics*, vol. 39, no. 10, 2021.

[6] S. C. Pereus and N. Rohyans, *Lean and Six-Sigma in Education*, Research and Analysis, School of Business Affairs, 2016. Available: https://www.asbointl.org

[7] S. K. G., A. Sarode, and S. Chandrakanth, "Implementation of Six-Sigma in Academia," *Preprints*, 2021. doi:10.20944/preprints202111.0198.v1

[8] A. Ghaleb, M. Heshmat, M. A. El-Sharief, and M. G. El-Sebaie, "Using fuzzy logic and discrete event simulation to enhance production lines performance: case study," in *2019 IEEE 6th Int. Conf. on Industrial Engineering and Applications (ICIEA)*, pp. 653–657, 2019.

[9] A.-R. S. Shehata, M. Heshmat, M. A. El-Sharief, and M. G. El-Sebaie, "Implementation of statistical process control techniques to reduce the defective ratio: a case study," in *Proc. Int. Conf. on Industrial Engineering and Operations Management*, pp. 666–675, 2018.

[10] R. M. F. Al-Therwah, M. Heshmat, M. El-Sharief, and I. M. Hassab–Allah, "Simulation modeling of student enrolment to solve operations problems: A case of the Saad Al-Abdullah Academy in Kuwait," *Alexandria Engineering Journal*, vol. 119, pp. 413–424, 2025. Available: https://www.elsevier.com/locate/aej

[11] Q. H. Mazumder, "Applying Six-Sigma in Higher Education Quality Improvement," in *American Society for Engineering Education Annual Conference*, 2014, Paper ID #8594.

[12] T. Vats and Sujata, "Lean Six-Sigma Model to Improve Student Performance," *IJCST*, vol. 6, no. 2, pp. April – June, 2015.

[13] C. R. S. Kumar, "Lean Six-Sigma Implementation in Engineering Institutions," in *Regulating Procurement Understanding the Ends and Means of Public Procurement Regulation*, 2021.

[14] M. Haerizadeh and V. Sunder M, "Impacts of Lean Six-Sigma on improving a higher education system: a case study," *International Journal of Quality & Reliability Management*, 2019.
[15] L. O. Jenicke, M. C. Holmes, and A. Kumar, "A framework for applying Six-Sigma improvement methodology in an academic environment," *The TQM Journal*, vol. 20, no. 5, pp. 453–462, 2008.
[16] B. Noori and M. Latifi, "Development of Six-Sigma methodology to improve grinding processes," *International Journal of Lean Six-Sigma*, vol. 9, no. 1, pp. 50–63, 2017.
[17] U. bin Mat, N. Buniyamin, P. M. Arsad, and R. Kassim, "An overview of using academic analytics to predict and improve students' achievement: A proposed proactive intelligent intervention," in *IEEE 5th Conf. on Engineering Education (ICEED)*, Kuala Lumpur, Malaysia, pp. 126–130, 2013. doi:10.1109/ICEED.2013.6908316
[18] C. Svensson, J. Antony, M. Ba-Essa, M. Bakhsh, and S. Albliwi, "A Lean Six-Sigma Program in Higher Education," *International Journal of Quality & Reliability Management*, vol. 32, pp. 951–969, 2015.

Appendix 1

Assessing and Improving Academy Performance Using Lean Six-Sigma
Section 1: Background Information

No.	Questions	Answer
Q1	What is your age (years)	_____ years
Q4	What year you are in now?	.....

Section 2: Factors affecting student performance

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**

No.	Statement	Answer				
		1	2	3	4	5
Academy: System, Vision and Mission						
1	The overall goals of the Academy are motivating towards high performance.					
2	All stakeholders (teachers, students) participate in setting objectives of the Academy.					
3	Vision and mission of the Academy are clear to teachers and students.					
4	All teaching and learning resources needed for improved performance are provided.					
5	Teachers are supervised to ensure the syllabus is completed on time.					
6	Staff appraisal meetings are regularly held to discuss strengths, weaknesses, and opportunities for academic improvement.					
Curriculum Design and Alignment						
7	All curricula are well-designed, comprehensive, sequential, and aligned with learning standards.					
8	Curricula are carefully planned and aligned with students' developmental levels.					
9	Curricula provide clear learning objectives, an appropriate scope and sequence, and opportunities for students to apply their knowledge in real-world contexts.					
10	The time allocated for each subject is sufficient to ensure comprehensive coverage of the curriculum and learning outcomes.					
11	Candidates are motivated by the incorporation of real-world applications of the topics.					
12	There is repetition in the course content.					
Environment						

13	The Academy has an appropriate learning environment.					
14	The Academy's facilities, including the classrooms, library, and labs, are suitable for study.					
15	The classroom at the Academy provides a good environment for learning.					
16	The academy's library provides books, research, and university theses that contribute to the formation of students' scientific knowledge.					
17	The academy's laboratory is modern and contributes to the development of students' performance at the academy.					
18	The academy has all the necessary financial capabilities.					
19	The academy offers valuable guidance and advice to its students.					
Candidates' Personality Related Factors						
20	Negative attitudes and fear of failure can reduce students' confidence.					
21	Fostering a growth mindset increases students' abilities through effort and practice.					
22	Active participation in the classroom increases performance.					
Teacher Related Factors						
23	Educators are perfectly addressing candidates' strengths and challenges.					
24	Lecturers use different teaching methodologies and practices.					
25	Lecturers provide help for candidates when needed.					
26	Teachers with weak teaching skills can negatively impact candidates' performance.					
27	The quality and competence of teachers play a pivotal role in candidates' academic achievement.					
28	Teachers at the Academy possess strong content knowledge, pedagogical skills, and the ability to foster a positive classroom environment.					
29	Teachers can identify students' individual needs, provide appropriate support and guidance, and facilitate meaningful learning experiences that cater to each student's unique learning style.					
30	There is a qualified academic staff suitable for the number of students in all subjects.					
Teaching Methods and Approaches						
31	Teachers are using traditional teaching methods that rely heavily on lectures and rote memorization.					
32	Teachers are using interactive and inquiry-based teaching methods.					
33	Teachers effectively differentiate teaching by providing diverse curricula, materials, and assessments.					
34	The academy provides peer interactions, collaborative learning opportunities, and a supportive environment.					
35	Students feel comfortable asking questions, sharing ideas, and participating in classroom discourse.					

36	The teaching methods followed by the teacher are appropriate.					
37	Mention the most important difficulties you encountered while studying.	…….. …….. …….. …….. …….. ……..				
38	What are your suggestions to improve academic performance?	…….. …….. …….. …….. …….. ……..				