

Implementation of the Six Sigma Methodology to Improve Learning Outcomes in Public Schools in the Kingdom of Saudi Arabia Using the National Qualifications Standard

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Abstract

The study aimed to assess the extent to which the Six Sigma methodology is applied to improve learning outcomes in public schools in the Kingdom of Saudi Arabia, based on the National Qualifications Framework, from the perspective of school principals. Using a descriptive-analytical approach, the researcher developed a questionnaire and conducted interviews to collect data. The study sample included 248 male and female principals randomly selected from public schools in Jeddah during the academic year 1446 AH. Findings revealed that the overall application of the Six Sigma methodology in improving learning outcomes was high, with an average score of 3.58 (SD = 0.68). Among the dimensions studied, strategic development ranked highest with a mean score of 3.71 (SD = 0.67), followed by problem-solving at 3.64 (SD = 0.89), both reflecting a high level of implementation. The dimension of radical transformation scored the lowest with a mean of 3.10 (SD = 0.60), indicating a moderate level of application. Additionally, statistically significant differences were observed based on academic qualifications, years of administrative experience, and the number of training courses attended. Principals holding a master's degree, those with less than five or more than ten years of experience, and those who had completed more training courses demonstrated higher application levels of the Six Sigma methodology. Based on these findings, it is recommended to strengthen professional development by providing targeted Six Sigma training programs for school principals, especially focusing on enhancing radical transformation practices. Further emphasis should be placed on encouraging advanced academic qualifications among school leaders and supporting continuous learning to sustain high-quality implementation. Additionally, fostering strategic leadership and problem-solving skills will further enhance the methodology's effectiveness in improving learning outcomes across public schools.

Keywords: Six Sigma Methodology, Performance Measurement Methodologies, Learning Outcomes Improvement

Introduction

In the rapidly evolving landscape of global education, there is an urgent need for educational systems to adopt modern, evidence-based methodologies that drive continuous improvement and enhance student learning outcomes. As education becomes increasingly linked to national development, labor market readiness, and global competitiveness, the evaluation and optimization of educational processes have become critical. In this context, assessing learning outcomes has emerged as a cornerstone for identifying gaps, guiding policy decisions, and ensuring that students acquire the necessary knowledge, skills, values, and attitudes required in the 21st century.

The significance of this study lies in its focus on the application of the Six Sigma methodology within the educational sector—particularly in Saudi public schools—to improve learning outcomes. This area of research is both timely and necessary, as it addresses the pressing demand for quality enhancement in education through structured, data-driven performance measurement tools. Understanding how Six Sigma can contribute to educational reform is crucial not only for policymakers and school administrators but also for educators, curriculum developers, and assessment specialists who are all integral to shaping effective learning environments.

By focusing on the implementation of Six Sigma, this study aims to explore how a well-established quality management framework from the industrial and corporate sectors can be adapted to serve educational goals. The utility of Six Sigma in this context lies in its potential to bring about systematic improvements, reduce inefficiencies, and support evidence-based decision-making across schools. This makes the study highly relevant to stakeholders at multiple levels—national education authorities, regional educational departments, school leadership teams, and the broader academic community—who are striving to meet the ambitious targets set forth in Saudi Vision 2030, particularly in creating empowered schools and a globally competitive student population.

The Ministry of Education in the Kingdom of Saudi Arabia, represented by the education departments across various regions, is making significant efforts to improve learning outcomes. The success of these efforts largely depends on the ability of educational administrations to plan, organize, and monitor these initiatives effectively. This includes the provision of fully equipped school buildings, well-structured curricula, and the qualification of school principals to lead the educational process with efficiency and effectiveness. Moreover, success is also contingent on the accuracy and credibility of assessment processes, which enable opportunities for possible improvements (Al-Bataina, 2019: 272).

A report by the Organisation for Economic Co-operation and Development (OECD), based on the results of the Programme for International Student Assessment (PISA), indicated a relationship between school effectiveness and student outcomes (Al-Subaie, 2011:102). While teacher quality has the greatest impact on students' motivation and achievement, assessment processes also play a critical role in enhancing educational outcomes.

The study by Ilal Linger & Heck (2011) recommended discussing issues related to the development and improvement of learning outcomes, noting their importance in assessing student learning and enhancing the quality of the educational process. Similarly, recent

research (Lenion et al., 2014) has demonstrated that learning outcomes have a significant positive impact on learning and are essential for evaluating student progress and improving the educational process.

Since educational systems—with all their components, procedures, and outputs—require continuous evaluation for improvement and development, international, national, and centralized assessments are considered among the most prominent tools for measuring and evaluating educational systems worldwide. Furthermore, enhancing student performance in international assessments is one of the key strategic indicators of the National Transformation Program 2020. This goal is actively pursued by educational departments, as it aligns with the fourth strategic objective of the Ministry of Education (Sharahi, 2020).

Recognizing that performance measurement methodologies are the cornerstone for enabling the education system to achieve its goals and improve learning outcomes, the Ministry of Education in Saudi Arabia has shown considerable interest in this area. This has encouraged increased focus among education departments on students' academic achievement and improving learning outcomes, which encompass the knowledge, skills, values, and attitudes students are expected to demonstrate upon graduation. This calls for an exploration of the extent to which the Six Sigma methodology is being applied to enhance learning outcomes.

Six Sigma is a performance measurement methodology and an integrated, highly structured management system aimed at improving various operational activities. It offers an administrative framework that equips leaders with analytical tools and techniques needed to solve problems and achieve the highest levels of quality (Khalid Saad Abdulaziz Bin Said, 2004, p. 66). It also combines effective leadership with employee engagement and empowerment. Moreover, the benefits of Six Sigma extend beyond increased profitability; employees at all organizational levels in institutions that implement Six Sigma find that focusing on customer satisfaction, clear operational procedures, accurate measurement, and tool development makes their work more efficient and rewarding—both morally and materially—while also reducing performance confusion (Pande & Holpp, 2002, p. 13).

Six Sigma is one of the modern approaches to quality development, and is considered a milestone in this field. It helps achieve optimal quality levels by identifying root causes of problems to ensure they are permanently resolved and do not recur. This methodology also contributes to the delivery of defect-free products and services, with a level of precision and perfection among the highest achievable (Hunold, 2014).

Hence, it is possible to assess the degree of Six Sigma implementation in improving learning outcomes in public schools across Saudi Arabia. This is especially important given the emphasis on enhancing educational systems to achieve learning outcomes—a priority area for the Ministry of Education due to its pivotal role in societal development and supplying the labor market with high-quality national talent. Amidst global competitiveness and the scientific, knowledge-based, and technological revolution, organizations are now racing to elevate the quality of their services. This necessitates positive engagement with the cultural and technical vision within the educational system, especially in the face of quality education challenges.

Public schools require continuous renewal and development of assessment and evaluation methodologies. The Six Sigma methodology can contribute significantly to developing the education system and improving the evaluation process to enhance learning outcomes. Thus, it is vital to assess the degree of Six Sigma's application as a modern and developmental approach focused on meeting the needs and expectations of educational service beneficiaries and enhancing learning outcomes to align with Saudi Vision 2030 objectives—specifically, preparing a globally competitive generation and achieving the concept of an empowered school.

Research Problem Statement

Educational systems—with all their components, procedures, and outcomes—require continuous evaluation for the purpose of improvement and development. Accordingly, international, national, and centralized assessments are among the most prominent tools used to evaluate educational systems around the world. Enhancing learners' performance in international assessments is considered one of the key indicators of the National Transformation Program 2020, which educational departments strive to achieve, as it aligns with the fourth strategic objective of the Ministry of Education.

Drawing from the researcher's 25 years of experience in the educational field—and given that performance measurement methodologies are the cornerstone for enabling the educational system to achieve its goals and support the improvement of learning outcomes—the Ministry of Education in the Kingdom of Saudi Arabia has paid significant attention to this area. This focus has encouraged increased interest among educational departments in improving their students' learning outcomes. Consequently, it has become necessary to assess the extent to which the Six Sigma methodology is being applied to enhance learning outcomes. Based on this, the researcher identified a strong need to explore the degree of implementation of the Six Sigma methodology in improving learning outcomes in public schools across the Kingdom of Saudi Arabia, in light of the National Qualifications Framework.

The problem of this study is embodied in answering the following main question: What is the current state of implementing the Six Sigma methodology in improving learning outcomes in public schools in the Kingdom of Saudi Arabia, in light of the National Qualifications Framework?

To answer this main question, the following sub-questions will be addressed:

Research Questions

1. What is the degree of implementation of the radical transformation dimension in improving learning outcomes in public schools in light of the National Qualifications Framework, from the perspective of school principals?
2. What is the degree of implementation of the strategic development dimension in improving learning outcomes in public schools in light of the National Qualifications Framework, from the perspective of school principals?
3. What is the degree of implementation of the problem-solving dimension in improving learning outcomes in public schools in light of the National Qualifications Framework, from the perspective of school principals?
4. What are the statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the average responses of school principals regarding the reality of applying the

Six Sigma methodology to improve learning outcomes in public schools in the Kingdom of Saudi Arabia, that can be attributed to the variables of academic qualification, years of administrative experience, and training courses in performance measurement and school evaluation methodologies?

Research Objectives

This study aims to achieve the following objectives:

1. To measure the degree of implementation of the **radical transformation** dimension in improving learning outcomes in public schools in light of the National Qualifications Framework, from the perspective of school principals.
2. To measure the degree of implementation of the **strategic development** dimension in improving learning outcomes in public schools in light of the National Qualifications Framework, from the perspective of school principals.
3. To measure the degree of implementation of the **problem-solving** dimension in improving learning outcomes in public schools in light of the National Qualifications Framework, from the perspective of school principals.
4. To identify **statistically significant differences** at the level of ($\alpha \leq 0.05$) between the average responses of school principals on the application of the Six Sigma methodology in improving learning outcomes, attributed to variables such as **academic qualification, years of administrative experience, and training in performance measurement and school evaluation.**

Significance of the Study

Theoretical Significance

1. The study derives its importance from the relevance of applying the **Six Sigma methodology** to improve learning outcomes, particularly in light of current trends emphasizing the enhancement of educational quality.
2. Understanding the reality of Six Sigma implementation in public schools, given its potential impact on improving learning outcomes at both the school and district levels.
3. The study is expected to **bridge a research gap** due to the limited number of studies addressing the application of the Six Sigma methodology in improving learning outcomes.
4. The researcher aspires to **enrich Arabic educational literature**—particularly in Saudi Arabia—by providing an evaluative study on measuring the application of Six Sigma to enhance learning outcomes from the perspective of school principals.

Practical Significance

1. The study's findings are expected to benefit **decision-makers and officials** (e.g., Ministry of Education and educational departments across the Kingdom) in adopting and activating the Six Sigma methodology to enhance learning outcomes, by developing clear and scientifically based improvement plans.
2. **School administrators and teachers** may benefit from the study by applying the Six Sigma methodology to improve learning outcomes within their institutions.
3. The study could contribute to enriching **practical field experience** through applicable roles and ideas related to performance measurement and its role in improving learning outcomes.
4. It may open new avenues for future **evaluative research** focused on measuring the application of Six Sigma in educational contexts.

5. The study may help **support school excellence units and decision-makers** in the Ministry of Education and educational departments by providing insights and recommendations for future improvement strategies.
6. **Training and professional development planners** may benefit from the study in identifying actual training needs related to performance measurement methodologies and school excellence.

Study Methodology

The study employs the **descriptive-analytical method**, as it is most appropriate for the study's objectives. Data collection relied on both **secondary and primary sources**, as follows:

- **Secondary Sources:** Books, research papers, academic theses, journals, and online resources.
- **Primary Sources:** A questionnaire specifically designed for this study, applied to gather the required data on the extent of Six Sigma application in improving learning outcomes. The **SPSS statistical software** will be used for data analysis and hypothesis testing.

Study Population and Sample

The population targeted in this study comprises public school principals within the Jeddah Governorate. This group represents the leadership responsible for managing and overseeing the educational processes in public schools across this region. Given the vital role principals play in shaping school performance and implementing educational policies, focusing on this population allows the study to capture insights from those directly involved in applying management methodologies and improving learning outcomes. The geographical focus on Jeddah Governorate ensures that the findings are relevant to the local educational context, taking into consideration regional characteristics and challenges that may influence school administration and performance.

To obtain a representative and unbiased view, the study employed a random sampling technique to select a sample of 284 principals, including both male and female leaders. This sample size is sufficiently large to provide reliable statistical results while reflecting the diversity of leadership styles, experiences, and school types within the governorate. By incorporating principals of both genders, the study ensures inclusivity and the ability to examine potential differences or similarities in perspectives across demographic variables. This methodological approach strengthens the validity and generalizability of the study's conclusions, providing a robust foundation for understanding the application of Six Sigma methodology in public school settings.

Literature Review

A growing body of research explores the application of the Six Sigma methodology in both educational and non-educational contexts, demonstrating its potential in enhancing quality and outcomes. Al-Atiqi and Deshpande (2009) conducted a foundational study on the use of Six Sigma in higher education in Kuwait. Their research demonstrated how structured quality management tools could be utilized to enhance the efficiency and effectiveness of academic institutions. They found that applying Six Sigma practices in universities could lead to process optimization and better alignment with educational goals.

Othman (2018) examined the role of Six Sigma in improving performance in the Kuwaiti Ministry of Communications. Although outside the educational sector, the study's emphasis on operational efficiency, waste reduction, and continuous improvement provides transferable insights that can be applied to education, especially in school management and administration. In a similar context, Al-Mutairi (2013) studied the feasibility of applying Six Sigma in services offered to Kuwait's industrial sector. The study confirmed that Six Sigma contributes to identifying root causes of service inefficiencies and enhancing service delivery, which aligns with the goals of educational institutions seeking to improve learning environments and academic support services.

Kamal (2019) explored the connection between Six Sigma practices and intellectual capital in Kuwait's Ministry of Health. His findings highlighted the role of quality frameworks in building knowledge-based institutions. The relevance of this study to education lies in its support for continuous professional development and strategic capacity-building—essential components of school improvement. Focusing on the educational sector, Al-Daihani (2010) assessed the feasibility and challenges of applying Six Sigma in school management in Kuwait. The study uncovered several barriers such as resistance to change and lack of training, yet emphasized the potential of Six Sigma in streamlining administrative tasks and improving educational leadership practices.

In a later study, Al-Daihani and Al-Ansari (2018) examined the effects of Six Sigma and internal auditing on audit quality at Kuwait University. They found that Six Sigma provided valuable tools for improving institutional accountability and reliability, showing promise for wider adoption in higher education. Al-Arefan (2021) provided a more recent perspective by exploring the readiness of Kuwaiti schools to implement Six Sigma, based on feedback from school principals. The research indicated varying levels of preparedness and highlighted the need for training programs that focus on leadership development and performance measurement—a critical insight for Saudi Arabia's educational context.

Beyond Six Sigma-focused research, several studies have addressed leadership and outcome assessment in education. Al-Hassan (2016) studied the supervisory role of school principals in improving student achievement in South Kordofan, Sudan. The research revealed that principals significantly influenced learning through classroom supervision, problem-solving, and managing student welfare—principles that align with Six Sigma's emphasis on leadership and process control. In the United States, Sebastian et al. (2016) explored how teacher leadership mediates the influence of principals on instruction and learning. Conducted in 534 elementary schools in Chicago, the study showed that fostering a positive school climate and empowering teachers were key drivers of student achievement. These findings support the collaborative and leadership-driven components of Six Sigma implementation.

Abu Eish (2016) investigated the assessment methods used to evaluate student learning outcomes at Taif University, identifying gaps in modern assessment practices such as peer assessment and performance-based evaluation. The study called for updated tools and methodologies—something Six Sigma can offer through its focus on measurable outcomes and evidence-based decision-making. In a similar context, Al-Dawood, Al-Mashari, and Abdelhamid (2016) examined whether assessment practices in Prince Sattam Bin Abdulaziz

University align with quality standards. Their findings revealed a moderate application of quality-based assessments and highlighted the need for systemic improvements, suggesting Six Sigma could serve as a structured model for aligning assessment practices with institutional goals.

Abu Khuzaim (2016) studied the use of observation as an assessment method in Qur'anic studies programs, focusing on evaluating cognitive and interpersonal skills. The study proposed that structured observation methods could play a significant role in assessing complex learning outcomes—mirroring the Six Sigma principle of gathering comprehensive, meaningful data. Lastly, Othman and Omar (2016) explored assessment practices for preparatory-year students at the University of Dammam. The study found a reliance on traditional methods and a lack of reflective or student-centered evaluation tools. Their recommendations included diversifying assessment practices and aligning them with national accreditation frameworks—goals well-served by a Six Sigma-based quality system.

The Results of the Study

The researcher utilized the Statistical Package for the Social Sciences (SPSS) to analyze the study data, ensuring the accuracy and reliability of the findings. Various statistical methods were employed, including Cronbach's Alpha to assess the reliability of the instrument, Pearson's correlation coefficient to verify internal consistency, Levene's Test for homogeneity of variances, ANOVA to examine statistically significant differences, as well as means, standard deviations, and percentages for each item and domain of the instrument. Frequencies and percentages were also calculated to identify the most and least frequent responses based on the five-point Likert scale.

The results of the study can be summarized as follows:

1. Overall Implementation of Six Sigma Methodology:
The degree of implementation of the Six Sigma methodology to improve learning outcomes in public schools in the Kingdom of Saudi Arabia—based on school principals' perspectives—was found to be high, with an overall mean score of 3.58 and a standard deviation of 0.68. This reflects a strong level of adoption of the methodology in the educational environment.

Implementation of Individual Dimensions

- The Strategic Development Dimension ranked first, with a mean of 3.71 and a standard deviation of 0.67, indicating a high level of implementation and a clear emphasis on long-term planning.
- The Problem-Solving Dimension came second, with a mean of 3.64 and a standard deviation of 0.89, demonstrating a commitment to addressing educational challenges through structured approaches.
- The Radical Transformation Dimension ranked third and last, with a mean of 3.10 and a standard deviation of 0.60, representing a moderate level of implementation, and suggesting potential barriers to initiating substantial systemic change.

Statistically Significant Differences

- There were statistically significant differences at the $\alpha \leq 0.05$ level related to the **educational qualification** variable, with those holding **master's degrees** reporting higher levels of Six Sigma implementation.

- Statistically significant differences were also found based on the **number of training courses**, favoring school principals who had completed more professional development in performance measurement.
- Additionally, differences emerged based on **years of administrative experience**, with higher implementation levels reported by those with **less than 5 years** and **more than 10 years** of experience, highlighting the value of both recent and extensive experience.

Discussion of Findings

In light of the study's findings, it is recommended that school principals adopt performance measurement methodologies, particularly the Six Sigma approach, to enhance learning outcomes and align with the objectives of Saudi Arabia's Vision 2030 and the fourth strategic goal of the Ministry of Education. The integration of these methodologies can serve as a catalyst for continuous improvement by focusing on reducing variability in educational processes and promoting data-driven decision-making, ultimately ensuring that national reform goals are not only met but sustained.

There is a pressing need to enroll school principals in professional development programs that focus on leveraging available resources to improve the quality of educational delivery. Equipping leaders with the skills to strategically use tools such as Six Sigma will enable them to identify gaps in teaching and learning, implement targeted interventions, and monitor progress in a structured and efficient manner. Such training can also foster a culture of accountability and continuous improvement within schools.

To achieve measurable improvements in student performance, it is vital to adopt an appropriate leadership style that aligns with the principles of quality education and supports sustainable development goals. Schools should prioritize leadership models that emphasize strategic thinking, collaboration, empowerment, and responsiveness to feedback. By fostering transformational leadership practices, schools can effectively align operational goals with instructional improvement initiatives.

It is recommended that a substantial portion of school leadership training be dedicated specifically to Six Sigma methodology. This will not only prepare school principals to implement the system effectively but also empower teachers to create supportive classroom environments conducive to learning. When both leadership and teaching staff are equipped with a shared understanding of quality management principles, it becomes easier to institutionalize effective practices that improve student outcomes.

Schools should be encouraged to conduct action research aimed at evaluating professional practices and instructional strategies. This form of research allows educators to reflect critically on their work, identify areas for development, and implement solutions in real-time. Action research also promotes a culture of inquiry and continuous growth, ensuring that improvements in learning outcomes are rooted in empirical evidence and reflective practice. Developing an integrated system for the implementation of Six Sigma within public education is essential. This system should outline clear protocols for performance measurement, process improvement, and quality assurance. A structured framework ensures consistency, transparency, and alignment with national educational standards. It also enhances the ability of school leaders to track progress and make informed decisions based on reliable data.

Ongoing professional development for all school staff is critical to improving learning outcomes. This includes targeted training for educators, administrative personnel, and support staff, with a focus on quality assurance, assessment strategies, and the use of performance metrics. By continuously investing in human capital, schools can sustain high-quality teaching and learning environments and adapt effectively to evolving educational demands.

For effective implementation, it is advisable that schools form dedicated Six Sigma teams composed of trained personnel responsible for managing quality initiatives. These teams should be tasked with defining responsibilities, developing improvement plans, monitoring performance, and ensuring accountability. The presence of such specialized teams reinforces a commitment to excellence and facilitates the successful integration of Six Sigma principles into the school's operational framework.

Collaboration among schools that have pioneered Six Sigma implementation should be actively promoted. These model schools can serve as hubs of innovation and professional learning, offering mentorship, sharing best practices, and providing support to other institutions. Peer learning and inter-school cooperation can accelerate the spread of effective quality improvement strategies and contribute to a stronger national education system.

Finally, it is essential to motivate school principals to engage in strategic planning that incorporates research-based practices focused on learning outcomes. Encouraging them to review their schools' strategic plans in light of recent research findings and to align them with national goals will foster more effective, future-oriented educational leadership. Strategic planning informed by evidence enhances decision-making and positions schools to be more adaptive and impactful in their efforts to improve student performance.

Conclusion and Recommendation for future Research

Future research is encouraged to examine the tangible impact of implementing the Six Sigma methodology on the overall performance of public schools. Such a study would provide valuable insights into how systematic quality management approaches translate into improved operational efficiency, student achievement, and educational outcomes. It would also help identify the key performance indicators (KPIs) that best reflect Six Sigma's effectiveness in the school environment, thereby guiding future implementation strategies. Another important area for future exploration involves identifying and analyzing the challenges and obstacles encountered during the implementation of Six Sigma in public education. These challenges may include limited resources, resistance to change, lack of training, or insufficient administrative support. Understanding these barriers from the perspectives of various stakeholders—such as teachers, administrators, and policymakers—can inform targeted solutions to facilitate smoother adoption of the methodology in diverse educational settings.

It would also be beneficial to study the role that Six Sigma plays in fostering a culture of excellence within schools. Such research could assess how the methodology supports continuous improvement, encourages innovation, and aligns school goals with broader national educational standards. By exploring the relationship between Six Sigma practices and excellence in leadership, teaching, and student engagement, the findings may offer a

roadmap for schools striving to achieve high performance and recognition in quality assurance programs.

Future research should evaluate the direct and measurable effects of Six Sigma implementation on student learning outcomes. This could involve longitudinal studies that track academic progress, classroom performance, and standardized test results before and after the application of Six Sigma tools and processes. By linking educational data with process improvement practices, such studies can provide empirical evidence to support the methodology's effectiveness in enhancing the quality of teaching and learning.

A focused investigation into the perceptions of school stakeholders—especially teachers and administrators—regarding the barriers to implementing Six Sigma would be highly valuable. Such research can delve into practical constraints, cultural resistance, policy gaps, and training deficiencies that hinder successful integration. Analyzing these viewpoints can offer grounded recommendations to policymakers and school leaders, ensuring more realistic and context-sensitive implementation frameworks.

Further research could explore how school principals contribute to the achievement of institutional excellence through the lens of Six Sigma or other quality frameworks. This line of inquiry might investigate leadership styles, strategic decision-making, team empowerment, and data-driven management. Such studies could be instrumental in developing leadership development programs that prepare school leaders to effectively spearhead quality improvement initiatives.

A promising research direction lies in assessing how the application of various performance measurement methodologies—including Six Sigma—affects learning outcomes in public schools. This research could compare schools that use formal performance tracking systems with those that do not, analyzing differences in academic performance, teacher effectiveness, and institutional accountability. The findings could contribute to a deeper understanding of how data-driven decision-making enhances educational quality at all levels.

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