

Research Article

## The Impact of Six Sigma on Madrasati Platform in Saudi Arabia

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### Abstract

Saudi Arabia is working to develop education based on high standards for both males and females. With E-learning, students may access it whenever they choose, from anywhere. The MoE introduced an E-learning platform that called Madrasati platform to keep up the process of education over the COVID-19 pandemic. The Six Sigma DMAIC methodology in the education field aims to standardize processes and reduce variability to improve educational quality. The paper aims to improve the Madrasati platform's quality by implementing Six Sigma to raise the value of E-learning in Saudi Arabia. The required data was collected through the online survey. It follows the Likert scale with five-point. The respondents of the survey were 266 of Saudi's students from different classes and their parents. 59% of students expressed satisfaction with the Madrasati platform. The collected data were analyzed through using SPSS software and determined by a Sigma level. The USL, LSL, and DPM for the present and suggested Sigma levels are identified when calculating the Sigma level. According to the results, Pareto and other diagrams were designed to illustrate the effects. Some improvement methods are suggested to be applied to increase the level of the platform quality.

**Keywords:** Six Sigma, DMAIC, E-Learning, Education, Madrasati Platform, Quality of Education, Saudi Platforms.

### 1. Introduction

Education considers the core of any country. It contributes to building modern society, raising the economy, and improving thinking. Well-educated individuals help their country to arise among the others [1]. Education has a personal and social impact. Saudi Arabia aims to achieve the vision of 2030 by depending on knowledge-based rather than oil-based. Moreover, it seeks to empower and support Saudi women through increasing the opportunities for careers or education [2]. It has worked to improve education with high standards for males and females. Improving education leads to executing high qualifications that can work for the country. With rapid development, education is affected by technology and becomes more useful. Traditional education is the fundamental method, but E-learning enhances teaching in an advanced way. The COVID-19 pandemic is the motivation to think smartly about how to improve education and use techniques to connect the learners with their teachers and continuation of the education process [3]. E-learning enables learners to access from anywhere such as at home to attend lessons. Moreover, the learner can use it to do their tasks, watch course videos, and connect with teachers and classmates [4].

The Ministry of Education (MoE) established the Madrasati platform to continuous the education process during the COVID-19 pandemic. The Madrasati is an E-learning platform that contains electronic tools to support teachers in teaching and achieving the education process objectives. It is designed for all public schools in Saudi Arabia and some private schools. It serves kindergarten and grades from 1st to 12th [5]. Madarsati platform provides two kinds of virtual classrooms that are synchronously and asynchronously enabling the teachers and learners to meet simultaneously. Moreover, it contains Microsoft Office, email services, and calendars to schedule. It improves the quality of teaching by providing collaborative sharing, interactive communication, and recorded videos, voices, and lessons [6]. Ensuring the quality and ease of these services is critical to increasing student satisfaction and allowing them to achieve optimal results. Students' satisfaction can be defined as an attitude resulting from an evaluation of the institution's educational experience, services, and facilities [7]. The Six Sigma methodology is one tool that has received a lot of attention in terms of improving educational quality. Six Sigma aims to reduce variability and standardize processes in order to achieve the desired quality level. The DMAIC (Define, Measure, Analyze, Improve, Control) cycle is at the heart of the Six Sigma quality initiative [8]. By reducing defects and errors, the Six Sigma methodology can significantly improve the

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quality of education. This strategy can assist in pinpointing areas that require improvement and create a more efficient method of delivering high-quality education. Educators can create a culture of continuous improvement and pursue excellence in all facets of teaching and learning by applying the Six Sigma principles [9]. Implementing Six Sigma in education can help institutions to improve the quality of education by reducing inefficiencies, optimizing resources, and enhancing student outcomes. To apply the Six Sigma framework in the education sector, it is essential to first delineate the key performance indicators of student achievement and establish an effective system for measuring progress. Subsequently, the team can proceed to identify and eliminate sources of variability that may compromise the quality of education [10]. The Six Sigma methodologies can facilitate the implementation of data-driven decision-making in schools. Through the analysis of data and identification of underlying causes of suboptimal performance, educators can take corrective action and develop targeted strategies to enhance student outcomes. Furthermore, Six Sigma can aid educators in prioritizing the areas that hold the greatest potential to impact student success, leading to a more efficient allocation of resources and prioritization of important initiatives [11].

This research paper aims to enhance the Madrasati platform's quality by implementing the Six Sigma methodology. The paper will explore the implementation of the DMAIC technique of the Six Sigma quality tool in the Madrasati platform. Additionally, the paper aims to identify the significant issues that could negatively impact the platform's quality and recommend potential solutions. To accomplish the goal of the study and optimize the level of quality in the Madrasati platform, the study has addressed some research questions. First, what are the current issues and problems related to the quality of the Madrasati platform?; second, what is the level of satisfaction among students and parents regarding the quality of the Madrasati platform?; third, what are the recommendations can be provided for future improvements to maintain the quality of Madrasati platform?.

This paper contains six sections starting with the introduction; the second section presents some works in the literature; the third section introduces the proposed hypotheses; the fourth one points out the methodology adopted in this paper, which includes five phases Define, Measure, Analyze, Improve and Control; the fifth section will deal with the results and discussions that have been drawn; and the sixth and last section is the conclusion.

## 2. Literature Review

As the importance of education is the several types of research about assessing and optimizing the quality in this field. Through this section, the related work

illustrates the quality of education, the quality of the Madrasati platform, and Six Sigma applications in several fields.

### 2.1 Quality of Education

Pangarso *et al.* [12], the study aims to assess the student's satisfaction with E-learning during COVID-19 in 2020. It has been done in a single university in Indonesia. The findings of this study can improve the quality of E-learning after the pandemic. First, it concludes the previous studies and defines the main hypotheses including lecturer quality and learning system quality. Then, to collect data, it used an online survey Google Forms to 722 respondents. After that, to test and analyze data, the Partial Least Squares - Structural Equation Modeling (PLS-SEM) software was used. It uses in several studies in top journals. The study has shown that high quality can enhance distance learning and make students satisfied. Moreover, it optimizes the student's interaction, and they are satisfied with E-learning from the beginning of COVID-19. The study found that the quality of E-learning needs to be studied more in future research. The theory failed to explain the lecturer's quality on students' satisfaction.

Najwa Basonbul [13], the study aims to clarify the need for qualified E-learning for Deaf learners in Saudi Arabia. It needs support from the Ministry of Education to improve a platform such as Madrasati. It illustrates the difficulty of learning for deaf students during COVID-19. To collect data, the study applied interviews with the teachers. The respondents were 1 deaf teacher and 29 teachers that hearing in Saudi Arabia. The questions were about suggestions for improvements and E-learning satisfaction for the deaf learner. The study found that 23 teachers are dissatisfied to continue using E-learning. There is a teacher who suggested developing IEN courses to be synchronized in translation. From a technical view, there must be continuous improvements in technical learning tools to enhance the performance of E-learning. About 11 teachers are satisfied if this happens.

Alrehili *et al.* [14], this study focuses on implementing Total Quality Management (TQM) concepts, defines the advantages of TQM in Higher Education Institutions (HEI), and provides some recommendations to enhance the quality of HEI. It suggests four solutions. First, applying the crucial factors to guarantee TQM by laying out a culture of quality enhancement and TQM concept between the employees. Continues improvement on policies and controls in the organization. Second, focus on Critical Success Factors (CSF) to motivate the team and reach the goals. Three, applying Plan-Do-Check-Act (PDCA) cycle. Fourth, applying the Six Sigma approach. As a result, the TQM raises productivity, improves communication, and satisfies customers and employees. The study recommends implementing TQM in universities due to the complicated systems and focuses on the evaluation process.

AL Thnayan *et al.* [15], this paper examines the impact of E-learning quality on student satisfaction and performance before and during the COVID-19 pandemic. By distributing a questionnaire to students in the Public Security Training City in Riyadh. The number of re- sponses collected was 352. The result of the data analysis was that the quality of the E-learning system positively impacted students' satisfaction and performance. Although in the beginning, they had difficulty dealing with the computer, so they were forced to learn how to use it to move forward in the educational processes.

Pham *et al.* [16], this study focuses on finding the relationship between the quality of E-learning and students' satisfaction. Moreover, explaining the effect of student satisfaction on student loyalty to E-learning. This study starts by collecting 60 items as quality attributes related to some measures (e.g., accuracy, reliability, ease of use, etc.). After that evaluated by two groups. The first group consists of six teachers who have experience in one online course. The second group consists of six students who study at least one online course. The data collected from the local university in Vietnam use E-learning for 10 years. The survey follows the Likert scale which is simple and more efficient. As a result, this study uses SmartPLS (Smart Partial Least Square) to analyze the data and explain how the student's loyalty to E-learning is affected by the overall quality and student satisfaction.

Adel Elswawi *et al.* [17], according to the widely used BlackBoard (BB), the study aims to develop the quality of E-learning and cybersecurity on BB. Moreover, it illustrates the importance of E-learning, its objectives, advantages, and quality of it. In addition to the future of cybersecurity in Saudi Arabia. There are factors in E-learning that should be focused on the quality side such as availability at any time, effective collaboration tools with colleagues, and facilitating continuous education. E-learning can eliminate barriers that exist in traditional education such as place, presence, and time. The components of E-learning are students, teachers, technical support managers, and technical support staff. The levels of E-learning categorize as basic, blend, full, and advanced enrollment. As the importance of BB in providing online courses as it is essential to be improved and updated to prevent security issues. The study recommends applying seminars and workshops for training programs in cybersecurity. Preparing the needed educational tools for an E-learning environment and continuously improving quality.

## 2.2 Quality of Madrasati Platform

Almaiah, Mohammed Amin *et al.* [18], the study aims to determine the factors that affect students using the Madrasati platform in Saudi Arabia. Moreover, it aims to improve the usage of this platform to be used in Saudi universities too. The quality factors focused on were the quality of the system, service, and content. The study has identified two questions about the factors that can support using the Madrasati platform and about the

student's perceptions of the platform in Saudi Arabia. The first question used the SEM method which is good for data analysis and examines the adoption of students. The second question used Statistical Package for the Social Sciences (SPSS) software to identify and analyze students' perceptions. To collect data, it applied an online survey to collect data from 3000 respondents of students from all levels in school. Moreover, it was sent to experts in E-learning to ensure the questions of the survey is clear. The result has shown a positive impact using the SEM method on the quality of Madrasati platform adoption. The result of students' perceptions using SPSS software was satisfied with 95% of students finding it easy to obtain the content, quizzes, and homework. Also, 96% were satisfied with the service quality in the platform and 82% with the system functionalities.

Badi Aldossry [19], this study stands on two research questions about the teacher's impression while using the Madrasati platform and its advantages of it. The questionnaire and interview are used to collect the data from three teachers who have one year of experience in E-learning. The duration of the interview is around 10 to 15 mins. As a result, the registration process in the Madrasati platform is complicated and requires signing in through the Tawakalna application and the teacher's role changed to a comprehensive role. Moreover, the advantages of the Madrasati platform are the electronic assignments and tests, and the lesson being recorded by voices and videos. Besides the disadvantages, the attention of students is less than the face-to-face lessons, and the complicated process of registration. Like any technical application, the interruption is a challenge and issue on the Madrasati platform. This study recommends connecting the team's program and Noor system with the platform. Moreover, make more research about the Madrasati platform and activate messages and notifications on the Madrasati platform.

Alkinani *et al.* [20], this study aims to explore the usability and effectiveness after applying the Madrasati platform from teacher impression. Furthermore, aims to find the gaps in the latest papers and recommends results to the teacher and the Ministry of Education. The System Usability Scale (SUS) and Computer System Usability Questionnaire (CSUQ) were used to collect the data. SUS is the most effective survey because of contains only 10 statement and follow the Likert scale which includes 5 points answers such as totally agreed and totally disagree. The language of the survey is Arabic language and checked by two Arabic professors. It was distributed using Google Forms to 200 teachers. The data was analyzed using SPSS software. As a result, there is a positive effect on the quality of teaching, the usability is raised and the information quality affects the teacher's perspective. This study recommends enhancing the awareness of students to use technology. Wesam Shishah [21], aims to find out the challenges of design, usability, and problems of the Madrasati platform from the point of view of teachers in the

Kingdom of Saudi Arabia. By conducting a questionnaire containing 24 questions in three sections. They related to age, gender, school level, teaching experience, and 16 questions from the CSUQ. CSUQ contains general questions, usefulness, and quality of information and interface. The number of responses obtained from teachers through the questionnaire is 759 teachers. In addition, semi-structured interviews were conducted with ten teachers. The results were as follows. First, the teachers were not satisfied with the usability. It turned out that the participants had problems navigating between pages. As well as compatibility issues and system messages. Also, many missing features such as Assignment notification, Synchronize the Madrasati Platform with the Noor system, sharing questions with other schools, Search filter by date in attendance report, and Save Sessions. The study was conducted while the platform is still new to most educators. So, the results may change as they become familiar with it.

Alfaifi *et al.* [22], aims to investigate users' satisfaction and attitude towards the Madrasati platform by using Twitter to collect data relating to the platform. In addition, the Microsoft Product Reactions Cards (MPRC) to judge whether the user is satisfied or not. The data collection was during these stages, the pre-classroom stage, the familiarization stage, the interaction stage, and the use stage. The study led to these results. First, the users were not satisfied at the beginning of the launch of the system. Second, it has been observed that user satisfaction increases gradually over time. Third, the reasons for dissatisfaction are due to errors that appear in the platform, such as user rejection and system slowdown. Users gain more experience with the use of the system. So, the outcome can change positively over time.

Ghaban and Wad [23], aims to review the effects of using games on students and measure their satisfaction with the Madrasati platform. First, by asking 40 teachers. It turns out that the platform lacks interactions, stimuli, and games. Therefore, 85% stated that they combine their lessons with tools or games such as Wordwall, Liveworksheets, and Quizzes for motivation. Second, they evaluated 123 students before and after the test. Also, during teaching, teachers use the fun stimulation elements built into the platform. The results of the comparison showed that most of the students' scores after the test were higher than those made before the test.

Alubthane and Fawzia [24], this study aims to evaluate the Madrasati platform from the female teachers' point of view. By distributing a questionnaire to 384 teachers. In addition to semi-structured interviews with five teachers. The results of the data analysis indicated that the most frequently encountered problems are related to login, technical problems, and Internet outages. It was proposed to solve technical problems, increase the speed of the Internet, train teachers, educate parents, and create incentive packages for teachers. Also, when returning to face-to-face education, the study suggests applying blended

learning. So that it does not exceed 10% for the first stage, for the intermediate stage it reaches 15%, and for the second stage, it reaches 20%.

Iman Ali Al-Muraie [25], the study aims to identify the problems of the Madrasati platform from the point of view of art education teachers. By publishing a questionnaire on 169 female teachers. The study found several problems, the problems related to the Madrasati platform ranked second. Among the problems mentioned is not considering the individual differences of students through the Madrasati platform. Also, the failure to train art education teachers to use the platform. Also, multi-media technology distracts the students. The study also recommended the design of an enriching virtual art exhibition on the Madrasati platform. Also, adding applications for drawing and artistic creativity within the advantages of the Madrasati platform. Finally, activating training programs to train art education teachers through the Madrasati platform

### 2.3 Six Sigma Applications

Hamdan Anwar *et al.* [26], the study aims to define and optimize the sustainability performance at United Arab Emirates (UAE) universities. It considers the staff, colleges, and students of the universities. The factors focused on were knowledge, behavior, concern, awareness, and attitude. The study used the Six Sigma DMAIC methodology. To collect data, the study applied a questionnaire technique to 646 respondents. The questionnaire was distributed to the staff, students, and colleagues. The result has shown that students have the least level of sustainability compared to others. The study determines the lowest level of sustainability in colleges. After brainstorming sessions to improve the result, the study suggests some points such as increasing the number of workshops and seminars about sustainability. Involve courses or topics about sustainability especially in the colleges that have the lowest knowledge. Hold competitions and awards to optimize the sustainability attitude. Moreover, define the students club of sustainability.

Ankesh Mittal *et al.* [27], the study aims to assess and improve the performance and quality of using rubber weather strips for cars done by XYZ company. The order of these strips has been reduced and rejected. Therefore, the rate of loss has increased for the company. The study decided to use the Six Sigma DMAIC methodology as a quality tool to enhance the procurement of the strips. The purpose of using DMAIC was to increase the amount of rubber strips ordered and reduce rejection of it. The objective is to decrease the rejection of strips from 5.5% to 2%. The study identified the main defects that affect the product, which are about 12 defects, and the rejection rate percentage per month. The analysis process includes a fishbone and Pareto chart to analyze and find solutions. To improve the rubber weather strips, the following points illustrate what should be done. Improve staff skills through

training. Control the speed of the injection compound through the flow control valve unit. There must be continuous maintenance. The rejection rate before was 5.5%, after implementing Six Sigma it becomes 3.08%. In a month, it saves costs about Rs. 15,249. Therefore, Six Sigma has a beneficial effect.

Batuta *et al.* [28], the research focuses on the flaws in white chocolate and seeks to improve the company's chocolate production method. The method for gathering and analyzing the data is DMAIC approach. Moreover, as the cause-and-effect analysis, a fishbone diagram was employed. The authors depend on qualitative data in order to reach direct information about the real situation. The data collections are two parts which are primary data that include the number of white chocolate products, the number of defects on it, and the types of defects. Besides the secondary data, collected from historical production data. As a result, the fishbone and Pareto diagram apply to understand the problems. The fishbone diagram helps to define the problems such as the workers having less skill in the supervision, and the machine being inconsistent due to the temperature degree of the room. The Pareto diagram determines the root and main causes of the problems in white chocolate. The peeled-off defect is the high defects on the white chocolate.

Abdulla [8], the study aims to detect and correct technical education errors utilizing the Six Sigma approach. The research concentrates on the quality standards proposed by the National Board of Accreditation India for Tier II Indian Engineering Colleges. The DMAIC methodology is implemented by the authors to boost and optimize the current systems using statistical and non-statistical tactics. The aim of the study is to equip high-schoolers with the abilities and knowledge they need to become adept mechanical engineers, based on the top client demands for both soft and hard skills. The research employs well-known Six Sigma tools like the Pareto chart, process capability analysis, and cause-and-effect diagram to rank and prioritize the crucial factors that influence educational quality. The study's outcomes highlight elements like versatility in the program curriculum, laboratories and workshops, and credibility among universities that had a risk priority number greater than 300 need improvement. This investigation offers valuable insights into applying Six Sigma in the education industry and increasing quality parameters in Tier II Indian engineering colleges. The findings could contribute to developing appropriate strategies and tactics for addressing educational imperfections on a global scale.

Hazra [29], conducted a study on the application of Six Sigma in education to improve its overall performance and quality. The study focused on the DMAIC process to enhance key elements of the educational system model, including infrastructure, faculty, project work, projects, activities, and others. The author formed a committee consisting of department heads, technical and general staff, and

students to measure the process. In the analysis phase, the SWOT analysis was used to determine the strengths, weaknesses, opportunities, and threats of the key elements of the educational system model. The paper improved all the key elements of the educational system and suggested changes for each element. For instance, the author recommended the use of fibers for a reliable, flexible, and high-quality technological infrastructure. The study also suggested providing opportunities for staff and students to experience professional techniques outside of the classroom to enhance teaching and learning. The success of Six Sigma in education depends on the commitment and effort of all stakeholders, including management, faculty, staff, and students.

Rackov *et al.* [30], this study aims to use the Six Sigma DMAIC approach to improve student performance and the quality of education by decreasing the number of dropouts. In the define phase, the project's goals are defined such as increasing the student's degree, understanding the root causes, and providing solutions then making a control plan for continuous enhancements in quality. In the measure phase, interviews and surveys were used. As a result, the Pareto diagram produced in the analysis phase to define the root cause which is the money and transfer to another the university. In the improvement phase, design a table to analyze the failure by the modes, effects, and causes. Finally, the PDCA cycle is used in the control phase to ensure the quality has regularly improved.

Al-otaibi [9], conducted a study to evaluate the implementation of Six Sigma methodology in Saudi Arabian universities in order to gain a competitive edge. The methodology relied on reviewing previous studies and research related to the research, using the Scopus database, and selecting only publications related to the Kingdom of Saudi Arabia. Six keywords were used in the search process, resulting in 12,279 studies in the initial search, and 48 articles and reviews in the final search. The literature was categorized into three main categories: organizational performance, Lean Six Sigma, and higher education. The findings indicated that while Six Sigma implementation is still in its early stages in Saudi Arabian universities, researchers are emphasizing the use of Six Sigma to improve organizational performance, efficiency, productivity, and customer satisfaction. The use of the Lean Six Sigma approach is also gaining popularity in higher education to improve the quality of instruction and delivery in response to student input. The study provides insights into the potential benefits of Six Sigma implementation in Saudi Arabian universities and highlights the need for further research in this area.

Kiran *et al.* [31], this study sought to apply the Six Sigma methodology at Presidency University in Bangalore, India. To identify and address sources of poor performance, the authors used the DMAIC approach of Six Sigma. Poor performance was defined during the define phase as over 65% of students receiving less than a 6.5 CGPA. For the measure phase, a

random sample of 75 mechanical students was taken. The authors discovered several causes of poor performance, including differences in student backgrounds and mindsets, unique teaching styles of teachers, and social and environmental factors. In the improvement phase, the authors suggested various solutions, such as implementing control charts to monitor and improve the educational process, enhancing the teaching skills of teachers, providing additional support to students, and creating a better learning environment. This study provides valuable insights into the challenges, benefits, and solutions associated with implementing Six Sigma in academia to improve education quality at Presidency University.

Kartika *et al.* [32], this study aims to use the Six Sigma DMAIC method and define its impact of it on the medicinal industry. The Likert scale was used for 382 random managers in the medicinal industry. This study uses SmartPLS for data analysis and Product Moment Correction (PMC) to determine the relationship between the dependent variable which is the performance of the medicinal organization and the independent variables which are the phases of six sigma such as (define, measure, and control). As a result, most managers are male, under 30 years and have been a worker for around 5 to 10 years. Furthermore, Six Sigma impacts positively the industry's performance by reducing recovery and enhancement costs. Besides the market share of the industry is raised and the workplace is more effective.

Sandu *et al.* [33], conducted a study on the improvement of Vocational Education and Training (VET) quality from the students' perspective using the DMAIC methodology of Six Sigma. The study utilized a questionnaire with 12 questions administered via a Google form to gather data, which was then analyzed by the authors. Quality control tools such as Pareto charts and Fishbone diagrams were used to identify factors hindering education quality and recommend appropriate solutions. The study identified inadequate internships during the industrial semester, inadequate time devoted to practicals, and lack of interpersonal skills among students as major factors affecting VET quality. Following the implementation of their recommendations and solutions, the number of unsatisfied students decreased, and the percentage of students rating good and very good increased leading to an overall 20 improvement in quality. The findings indicate that the quality of VET has been enhanced, with a higher number of students now satisfied with the new system.

Shaikha Bumjaid *et al.* [34], the study aims to improve the quality in HEI at the Kingdom of Bahrain by using Six Sigma approach. Six Sigma has an appropriate impact on quality of products or services. The study wants to show how the effective of using Six Sigma approach in education. The methodology of this study was DMAIC methodology. The study defines the objectives then applied questionnaire technique to 357 respondents. The respondents represent the HEI's

personnel. The result has shown the effective role of Six Sigma on employee's performance was raised and accepted by employees about 78%. 56.7% of Bahrain institutions use Six Sigma DMAIC approach as a tool to optimize quality. Applying Six Sigma on HEIs improve productivity, reduce error rates, eliminate redundancy, and has positive impact on employee's performance. To improve the performance, the study recommends some points such as support employees to give their opinions of improvements, ensure data transfer with high quality, and ensure the quality policy is well-clarified.

Kremcheeva *et al.* [35], aims to explore the Six Sigma methodology and its implementation in optimizing the educational process. Through the analysis of regulatory documents and a focus on practical features, the study develops a reliable and measurable system of performance targets for assessing effectiveness. The benefits of Six Sigma in an educational institution are highlighted, including effective resource allocation, improved quality of the educational process, and optimized learning time. The use of Six Sigma also reduces variability in target indicators and ensures compliance with the requirements of students, teachers, and the state. Overall, the study aims to adapt Six Sigma for use in education and analyze implementation difficulties. The research method used is the analysis of scientific data and systematization, with target performance indicators developed from literary sources and regulatory documents.

Vijaya Sunder M. and Jiju Antony [36], this paper aims to present an effective application of Lean Six Sigma (LSS) with six sigma methods in higher education services. To identify the importance of excellence in quality and total quality management. Also, it proposes a conceptual framework for the dissemination of LSS in institutions of higher education by using the published literature on LSS as sources. The results concluded that the six-stage LSS conceptual framework is applicable to higher education institutions. The main feature of the proposed model was to involve the students from the beginning of the journey of excellence in quality. Through interviews and group discussions. To create a list of measurable projects such as improving student success rate, improving faculty feedback, reducing student absenteeism, and improving student placement rate. One of the limitations of this study is the lack of testing of the proposed conceptual framework.

The previous research explains the importance of quality in education, Madrasati platform's quality, and the impact of Six Sigma in several fields.

### 3. The Proposed Hypothesis

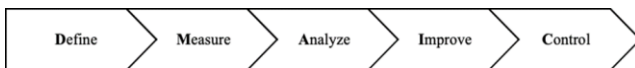
Based on the previous literature review, there are several factors that can affect the quality of the platform and E-learning process. This research has proposed three hypotheses as follows: Hypothesis 1 (H1): Design quality affects the students' performance in E-learning. Hypothesis 2 (H2): Students need access to more information accurately in the platform. Hypothesis 3 (H3): Communication quality tools between the



students and teachers need to be improved in the platform.

**4. Methodology**

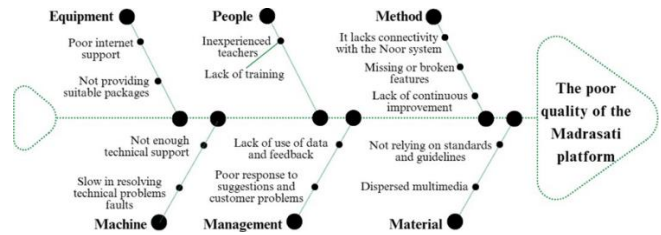
Six Sigma rather than other methods that are used for improvements, it is a practical method. It follows collections of standards and principles for solving specific problems in the fields. Six Sigma depends on real facts to provide real solutions for defects. It ensures the continuous enhancement of all factors, especially the quality of the organization [37]. The Madrasati platform considers an important E-learning platform in Saudi Arabia. Due to its importance, it needs continuous improvements. The Six Sigma DMAIC approach was the research methodology used. The DMAIC approach stands for Define, Measure, Analyze, Improve, and Control as shown in Figure 1 [38]. This approach focuses on improvements in several areas to accomplish the goal. It starts with defining problems or goals and ends with control and more improvements. The define phase is to identify, understand, and prioritize the goals and problems. Then, check certain data and gather needed data to measure the current performance. Then, analyze and assess the collected data to discover possible solutions that will help to accomplish the goals. After that, the improvement phase is to find and choose the best solutions to carry out. In the last phase, control and maintain the solutions are working well and efficiently [38].



**Fig.1** DMAIC Model

**4.1 Define Phase**

Through this phase, the issues and objectives must be determined as the first phase in the DMAIC approach. It is useful to well-understand all aspects of the field and achieving goals. The main objective is to increase the level of quality in the Madrasati platform in several areas. The chosen areas were design, information, and communication quality. Therefore, enhancing the quality of the platform’s design raise the students’ performance and participation. Enabling access to more trusted resources and information to raise the level of quality and satisfaction. Adding new interactive tools to improve the communication between the students and teachers. Furthermore, identifying the current situation and suggested Sigma level for defects and improvements of the Madrasati platform. Figure 2 shows the Fishbone diagram that is designed to define the possible causes of the poor quality of the Madrasati platform. It explains six causes with subcauses that affect the quality of the Madrasati platform.



**Fig.2** Fishbone Diagram

**4.2 Measure Phase**

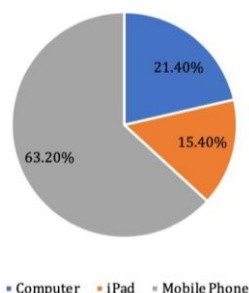
In this phase, effective measurement is used to measure the problems and their causes. It helps to find the appropriate solutions for the problems. This research paper collects the data from students and parents through the survey. The survey was designed using Google Forms and contains 13 questions. The questions were designed to explore the quality of the platform by focusing on the three mentioned hypotheses, and the possible methods to improve the level of the platform’s quality. It follows the Likert scale to measure the answers. It is considered the most effective scale due to its ability to quantify the responses. The Likert scale includes five main points (e.g., strongly agree, strongly disagree, neutral, agree and disagree) [39]. The survey was distributed to different levels of students from 1st to 12th class in different Saudi schools that use the Madrasati platform as an E-learning platform with the participation of their parents. The respondents were 266 from a sample of students and their parents who use the Madrasati platform. The responses were according to their point of view and their experience through using the Madrasati platform.

**4.3 Analysis Phase**

The analysis phase helps to understand and identify the problem and root causes. The Statistical Package for the Social Sciences (SPSS) was used in this research paper to analyze the responses to the survey. It is considered the most used software to analyze data and is used in studying social sciences and education problems. This section contains the questionnaire analysis, SPSS analysis, and Sigma level analysis.

**A. Questionnaire Analysis**

Students were asked to respond to a questionnaire consisting of 13 questions related to their experience and satisfaction with using the Madrasati platform to ensure the quality, ease, and continuity of E-learning. By responding on a five-point Likert scale ranging from “strongly agree” to “strongly disagree”. Question (1) was about “the type of device used to access the Madrasati platform”.



**Fig.3** The Percentage of Devices Used to Access the Madrasati Platform

The result as shown in Figure 3 was that more than half of the students use their mobile phones to access the platform at a rate of 63.2 %, while the iPad was 15.4 % and the computer was 21.4 %.

It is important to mention that questions from 2 to 9 were related to the current features of the Madrasati platform. Question (2) examines how easy it is to solve questions of the type “match columns A with B”. Some of the students did not agree with that 22.9 % strongly disagreed, 24.1 % disagreed, and 14.3% neutral. The responses to the question (3) show that more than half of the students agreed on the ease and effectiveness of communication between them and their teachers through the Madrasati platform 20.7 % strongly agree and 30.1 % agree. More than half of the students answered question (4) that the study schedule is clear and updated regularly 33.5 % strongly agree and 44.7 % agree. Add to that, most of them agreed that they can print the study schedule easily 22.9 % strongly agree and 33.1 % agreed with the question (5). Question (6) shows more than half of the students could see their results through the Madrasati platform. Some of the students had difficulties with that 13.9 % strongly disagreed, 16.9 % disagree, and 12% neutral. In question (7), more than half of the students expressed that the educational resources on this platform are multiple, diverse, and meet all cognitive needs. As 37.6 % of them agreed with that, and 19.9 % strongly agreed. More than half of the students agreed that the educational activities in the Madrasati platform are appropriate and purposeful. As 32.3 % of them agreed with that, and 16.2 % strongly agreed in question (8). In question (9), it measures the extent to which students feel completely satisfied with the Madrasati platform. It indicates that half of the students are satisfied with the Madrasati platform 24.8 % strongly agree and 34.2 % agree.

The following questions from 10 to 13 examine the students’ preferences. More than 86.8 % of the students strongly desire to develop the interface of the platform and put a print icon for each of the (schedules, reports, etc.), in question (10). An additional question (11) measured the extent to which students prefer to provide the feature of sending notifications about new assignments. Most of the students preferred to provide this feature on the platform 57.7 % strongly agree and 28.9 % agree. Also, more than 39.8 % of the students

strongly prefer and 36.1% prefer to link the platform to the Saudi Digital Library website to achieve optimum utilization and acquire the research skills, in question (12). Question (13) indicates the students’ strong desire to obtain an updated daily study schedule with times on the home page 47 % strongly agree and 39.8 % agree.

The Pareto diagram, known as a Pareto analysis, is an analytical tool in the form of a bar and curve graph. It is an effective tool for quality control and is used to identify the most common factors causing defects and problems. The defects were arranged in descending order according to the frequency, and the cumulative percentage for each defect was calculated as shown in Table 1, this allows us to focus on addressing the most matter issues to be addressed most effectively. Despite the simplicity of the Pareto diagram, it can be considered one of the most powerful and common problem-solving tools, allowing us to focus on major defects and solve them to get the most improvements [40].

The Pareto chart identified the top causes of defects in the Madrasati platform and provided insight into the most critical areas that need improvement. As shown in Figure 4, the Pareto diagram consists of a bar chart and a line graph. The bar chart shows the frequency of each cause of a malfunction, while the line graph shows the cumulative percentage of the causes. The reasons are arranged in descending order, and the cumulative percentage is calculated by adding the percentage of each reason to the percentage of the previous reason. It shows the top three causes of defects, which are” It is not easy to solve questions of the type that match columns A with B,” Communication between the student and the teacher through the platform is limited and ineffective” and” The results of the” Certificates” for students cannot be viewed through the Madrasati platform”. Therefore, addressing these causes should have the most significant impact on improving the Madrasati platform.

**Table 1** Pareto Diagram Data

Cause of Defect	Frequency	Cumulative	Cumulative (%)
It is not easy to solve” Match columns A with B” questions	125	125	24.51%
Communication between students and teachers is ineffective	83	208	40.78%
The results and Certifications cannot be viewed	82	290	57.86%
The class schedule cannot be easily printed	66	356	69.8%
Educational activities are limited in the platform	64	420	82.35%
Educational resources are limited in the platform	57	477	93.53%
The class schedule is not clear and is not updated periodically	33	510	100%
<b>Total</b>	<b>510</b>	-	-



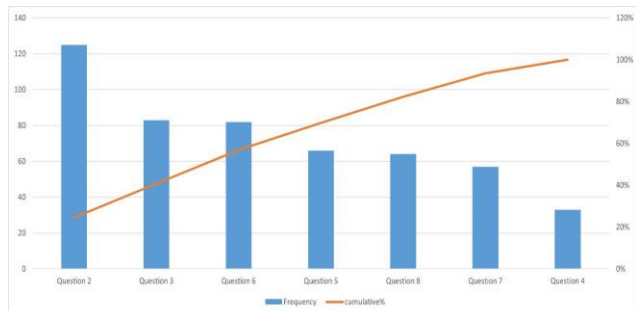


Fig.4 Pareto Diagram

B. SPSS Analysis

Table 2 shows the descriptive statistics of the quality of the Madrasati platform and students’ satisfaction. This statistical data was obtained from the SPSS analysis tool.

Table 2 Descriptive Statistics for the Quality of Madrasati Platform and Students’ Satisfaction

Question		1	2	3	4	5	Mean	Std. Dev
Q1	N	61	64	38	53	50	2.88	1.450
	%	22.9	24.1	14.3	19.9	18.8		
Q2	N	27	56	48	80	55	3.30	1.288
	%	10.2	21.1	18.0	30.1	20.7		
Q3	N	6	27	25	119	89	3.97	1.020
	%	2.3	10.2	9.4	44.7	33.5		
Q4	N	34	32	51	88	61	3.41	1.310
	%	12.8	12.0	19.2	33.1	22.9		
Q5	N	37	45	32	63	89	3.46	1.449
	%	13.9	16.9	12.0	23.7	33.5		
Q6	N	12	45	56	100	53	3.52	1.123
	%	4.5	16.9	21.1	37.6	19.9		
Q7	N	21	43	73	86	43	3.33	1.160
	%	7.9	16.2	27.4	32.2	16.2		
Q8	N	15	38	56	91	66	3.58	1.170
	%	5.6	14.3	21.1	34.2	24.8		

\*\*1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly agree

The “N” refers to the frequency of the question and “%” refers to the percentage of it. The highest average obtained was from question 3 : (The study schedule is clear and updated periodically) with a mean of 3.97 and a Standard deviation of 1.020. Followed by question 8 : (I feel satisfied with my experience with the platform) with a mean of 3.58 and a Standard Deviation of 1.170. Followed by question 6 : (The educational resources on the platform are varied) with a mean of 3.52 and a Standard Deviation of 1.123. Followed by question 5 : (I can view my results/certificates/marks in the platform) with a mean of 3.46 and a Standard Deviation of 1.449. Followed by question 4 : (I can print the class schedule easily) with a mean of 3.41 and a Standard Deviation of 1.310. Followed by question 7 : (Educational activities on the platform are purposeful) with a mean of 3.33 and a Standard Deviation of 1.160. Followed by question 2 : (The communication between teachers and students is easy) with a mean of 3.30 and a standard deviation of 1.288. Followed by question 1 : (I can easily solve the type of “match columns A with B”) with a mean of 2.88

and a Standard Deviation of 1.450. So, the weighted average for the first section of the questions was 3.43125. Therefore, according to the five-point Likert scale as shown in Table 3, the trend of (the quality of the Madrasati platform and students’ satisfaction with it) indicates (agree). Since 3.43125 lies in the interval [3.41-4.20]. These results are shown clearly in Figure 5

Table 3 Discretionary Scale According to the Five-Point Likert Scale

5-Points Likert scale description	Value	Weighted mean in interval range
Strongly disagree	1	[1.00 -1.80]
Disagree	2	[1.81 -2.60]
Neutral	3	[2.61 -3.40]
Agree	4	[3.41 -4.20]
Strongly agree	5	[4.21 -5.00]

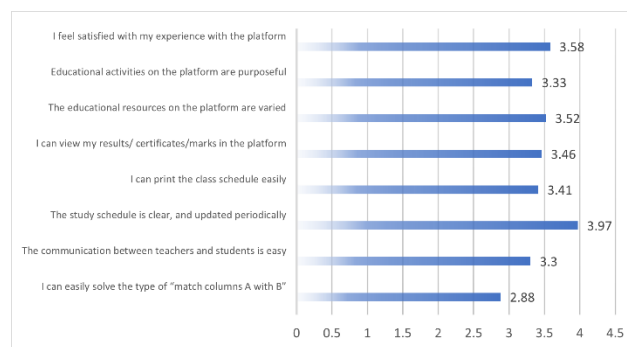


Fig.5 The Mean Value for Each Question

C. Sigma Level Analysis

To calculate Sigma level by five-point Likert scale data, one needs to calculate the mean and standard deviation of the data for each question as written in Table 6. Then, determine the Upper and Lower Specification limits (USL and LSL). These are the values that define the acceptable range of variation for the process. In this paper, the USL is 5 and LSL is 3; this means the responses below 3 points that are strongly disagreed and disagreed will be considered dissatisfaction or defects. Finally, estimate the Defects Per Million (DPM) rate and the Sigma level for each question. The DPM rate is the percentage of responses that fall outside the specification limits. It was calculated according to the formula (1) [33]:

$$DPM = \frac{Defects}{SampleSize} \times 1000000 \tag{1}$$

In Table 4 below, based on the collected data from the survey, DPM values were calculated, and the current Sigma levels were determined for questions from 2 to 9. The Sigma levels were identified based on the static values in Table 5 [41]. Moreover, to accurately determine the values of the Sigma levels, a calculator from datatab.net was used [42].

**Table 4** The Sigma Level of Each Question

Question	DPM	Sigma Level
Q2	469924	1.58
Q3	312000	1.99
Q4	124060	2.65
Q5	248120	2.18
Q6	308270	2
Q7	214285	2.29
Q8	240601	2.2
Q9	199248	2.34

**Table 5** The Sigma Level Values

Sigma Level	Defects per Million	Yield
6	3.4	99.99966%
5	230	99.977%
4	6,210	99.38%
3	66,800	93.32%
2	308,000	69.15%
1	690,000	30.85%

4.4 Improve Phase

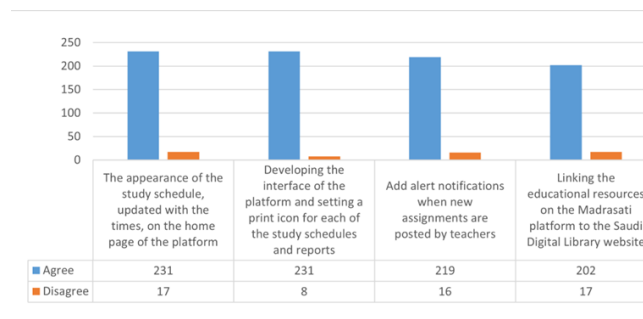
In the Six Sigma DMAIC cycle, the fourth stage is known as 'Improve'. The main objective of this phase is to address the issues identified in the previous three stages and come up with a viable solution [8]. The Improve phase centers on generating ideas to eliminate sources of variability in the process. It involves testing and standardizing potential solutions. By comprehending how particular inputs impact the outputs, a plan to regulate the process can be formulated [43]. Table 6 shows the second section of the survey questions, which are about the preferences and features that students want to provide in the Madrasati platform. The weighted average for the second section was 4.265. It indicates (Strongly Agree). Since 4.265 lies in the interval [4.21-5.00] in Table 3.

**Table 6** Descriptive Statistics for Improving the Quality of the Madrasati Platform

Question		1	2	3	4	5	Mean	Std. Deviation
I would like to develop the interface and put print icon	N	3	5	27	78	153	4.40	1.833
	%	1.1	1.9	10.2	29.3	57.5		
I would like to have notification when new assignment is posted	N	7	9	18	73	146	4.35	1.959
	%	2.6	3.4	6.8	27.4	54.9		
I prefer to link the educational resources to Saudi Digital Library	N	6	11	47	96	106	4.07	1.971
	%	2.3	4.1	17.7	36.1	39.8		
I prefer to show the daily school schedule updated in homepage	N	8	9	18	106	125	4.24	1.942
	%	3.0	3.4	6.8	39.8	47.0		

Based on the results in Figure 6, all four suggestions have received relatively high levels of agreement from the respondents, with agreement ranging from 202 to 231 out of the total of respondents. This indicates that the suggestions are generally well-received by the users of the platform. However, there are some differences in

the degree of agreement for each suggestion. The following points illustrate the suggestions for development from the most accepted to the lowest one. The first suggestion, which involves showing an updated study schedule on the home page of the platform, also received agreement from 231 respondents, but had a slightly higher degree of disagreement, with 17 respondents expressing disagreement. This shows that there is still a general agreement that this suggestion is good.



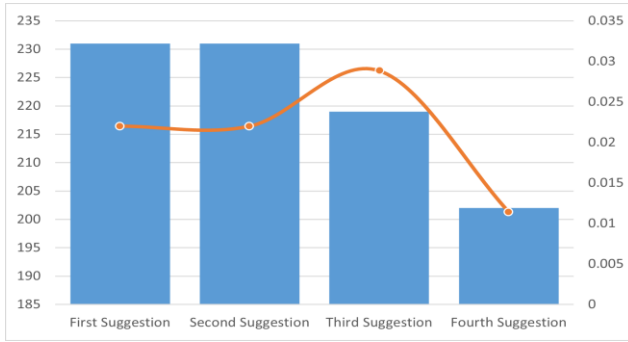
**Fig.6** Agreed and Disagreed Opinions on the Proposed Improvements

The second suggestion, which involves developing the interface of the platform and adding a print icon for study schedules and reports, received agreement from 231 respondents and disagreement from only 8. This suggests that there is a strong consensus among the respondents that this suggestion would be beneficial.

The third suggestion, which involves adding alert notifications for new assignments, received agreement from 219 respondents and disagreement from 16. This suggests that there is also a strong consensus that this suggestion would be beneficial.

The fourth suggestion, which involves linking educational resources to the Saudi Digital Library website, received agreement from 202 respondents and disagreement from 17. Overall, respondents seem to generally support all suggestions in a very high and positive way. The disagree responses were very small compared to the number of agreements, so all the research's suggestions received high approval. Therefore, all improvement suggestions will be implemented.

The results in Figure 7 presented in the chart are linked to a questionnaire, where respondents were asked to rate and provide feedback on various improvements for the Madrasati platform. Frequency refers to the number of times the respondents mentioned each suggestion, while the normal distribution represents the percentage. A normal distribution is a statistical term used to describe the distribution of a set of data points. It is a bell-shaped curve that is symmetric around the mean, with most of the data points clustered around the mean and fewer points further away from it. These results show that there are several suggestions that must be made to the platform, aimed at improving its usability and functionality.



**Fig.7** The Frequency of Four Suggestions for the Platform of Madrasati

The given results show the frequency of four suggestions for the platform of Madrasati. The first two suggestions have the same frequency of 231, indicating that they are equally popular among the users. Both aim to enhance the user experience by providing a more convenient and accessible way of accessing study schedules and reports. By adding a print icon, users can easily print out schedules and reports, while displaying the updated schedule on the home page allows users to quickly check their schedule without having to navigate to a different page. The third suggestion, with a frequency of 219, proposes the addition of alert notifications when new assignments are posted by teachers. This suggests that users would like to be notified when new assignments are available, which can help them stay on top of their work and prevent missing deadlines. This feature can improve engagement and increase the effectiveness of the platform. The fourth suggestion, with a frequency of 202, proposes linking the educational resources on the Madrasati platform to the Saudi Digital Library website. This would provide users with a broader range of resources and make it easier for them to access information from different sources. This improvement can improve the quality of education and enhance the platform’s credibility as a reliable source of educational material.

According to the survey’s data about the four suggestions in Table 6, the values of DPM were calculated. Besides the suggested Sigma level was identified for each suggestion. The suggested Sigma levels were classified based on the Table 5 and calculated from datatab.net Six Sigma calculator [42]. Table 7 shows the DPM values and Sigma level for each proposed suggestion. Besides the suggested improvements in the survey, the study has found other improvements that can be suggested due to the need for it. To solve the design problems with different screens’ sizes such as matching columns A with B matters with the device type.

**Table 7** The Sigma Level of Each Suggestion

Suggestions	DPM	Sigma Level
S1	63909	3.02
S2	30075	3.38
S3	60150	3.05
S4	63909	3.02

The survey has shown the mobile phone is difficult to solve this type of question while using the computer is much better. This can be improved by applying testing methods or employing an expert to develop the interfaces. Moreover, the difficulty of finding the marks and certificates in the platform can be improved by linking the Noor system to the Madrasati platform’s website.

Overall, the results suggest that users are looking for improvements that enhance the platform’s usability and provide them with more resources to support their education. By implementing these improvements, the platform can increase user satisfaction, engagement, and effectiveness, ultimately contributing to the success of the users.

#### 4.5 Control Phase

In the control phase, the focus is on ensuring that the implemented solutions continue to work effectively and efficiently over time. This can involve monitoring and measuring the impact of the changes made and making any necessary adjustments or improvements to maintain the quality of the Madrasati platform. It can also involve developing a plan for ongoing maintenance and updates to ensure that the platform remains up-to-date and continues to meet the needs of students and teachers. Additionally, training and development programs can be put in place to ensure that everyone involved fully understands the solutions implemented, their importance, and how they work together to improve the platform’s overall quality [31]. Plan, Do, Check and Act are the steps of the PDCA cycle. The PDCA cycle is a better method used to control a problem that may occur in an industry. It is a tool of TQM used to ensure continuous enhancement. PDCA helps to be aware of the deviations and modify them to accomplish the goals and success [44]. Therefore, each problem at the Madrasati platform should follow the four steps of the PDCA cycle. It helps to be aware of the deviations and modify them to ensure the quality of the Madrasati platform and raise the E-learning’s value. Table 8 illustrates each step of PDCA that is proposed for use in the Madrasati platform.

**Table 8** PDCA Cycle to Control the Quality of Madrasati Platform

Step	Process
Plan	Define the problems in the Madrasati platform, identify the requirements and create improvement plan.
Do	Do improvement plan.
Check	Analyze the data and measure the performance.
Act	Review the result and act on learned lessons and feedbacks from students.

### 5. Results and Discussion

The finding of this research paper examined in this section. Studying the impacts of using Six Sigma on the

quality of the Madrasati platform is the paper's aim. The DMAIC approach helps to define the problems and evaluate the solutions to achieve the paper's aim. After collecting and analyzing the data, this section discusses the results based on the proposed research hypotheses mentioned in section 3.

The first hypothesis (H1) shows the student's performance is influenced by the quality design of the Madrasati platform. According to students' perspectives on the ease of solving match columns A with B questions in the platform, 22.9 % of students strongly disagree and other students 24.1 % disagree. That means, the students faced difficulties with the interface of the Madrasati platform, affecting their performance. Therefore, the research has suggested employing an expert to improve the design and interface of the Madrasati platform. This improvement was accepted by 86.8 % of the students who prefer to improve the platform's interface to include icons for (schedules and reports). Based on the second hypothesis (H2), which contains the need for more accurate information that is provided to students on the Madrasati platform. Especially, the 10th to 12th classes require access to more accurate information in preparing for the university and its research. The research has suggested linking the Saudi Digital Library with the Madrasati platform to make the platform valuable. This improvement was accepted by 39.8 % strongly agree and 36.1 % agree of students. Moreover, the students face some difficulties in finding their marks. To provide trusted grades and certificates from the Noor system, the Madrasati platform can be linked with the Noor system as this study has said [19]. The third hypothesis (H3) needs to improve the communication tools between the students and teachers on the platform. Activating notification features when new homework/exams are posted by a teacher will raise the participation level of the students. 57.7 % strongly agree, and 28.9 % agree of students to activate this feature. Overall, 59 % of the respondents were satisfied using the Madrasati platform. Therefore, the mentioned hypotheses have focused on helping the reasearch to achieve the purpose of increasing the positive and correct impact of the study.

### Conclusion and Future Work

The quality of education contributes to increasing the value of the society. In this era of technology, E-learning platforms play a big role to spread knowledge. In Saudi Arabia, the Madrasati platform is a primary E-learning platform that is used in schools from 1st to 12th class. This paper has focused on improving the quality of the Madrasati platform by using the Six Sigma DMAIC approach. There are three defined hypotheses of the quality based on the literature review which are design quality, information quality, and communication quality. The DMAIC approach started with defining the problems and objectives, then measuring the issues was done using an online survey. The survey has created to collect the required data and distributed to the students

with the participation of their parents. The survey follows the Likert scale with five points and the respondents were 266 students and parents. The SPSS software was used to analyze the collected data from the survey. Based on the analysis of the survey data, it was found that the percentage of students' satisfaction about the Madrasati platform was 59%. Moreover, this study has suggested some improvements that optimize the level of platform's quality based on the hypotheses. The Sigma level was calculated through this study for the current and suggested situation of the Madrasati platform. The calculations included the DPM values and Sigma levels for each defect and the four suggested solutions. For future work, expanding the scope of the study to include more participants from all regions of Saudi Arabia and studying the impacts of Six Sigma on the quality from teachers' and school administrators' perspectives. Moreover, studying the impact of using an application for the Madrasati platform on quality and student satisfaction.

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