

RESEARCH ARTICLE

## Applied Six Sigma theory to reduce the drop-out rate among the students: systematic review

Monojit Pal<sup>1\*</sup>, Suparna Ghosh<sup>1</sup>

<sup>1</sup>Department of Education, Jadavpur University, Kolkata-700032, India

Corresponding Author: Monojit Pal, monojit111k@gmail.com

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### Abstract

Quality education is a prerequisite and essence of human development. At present, India has improved a lot, but, in some cases, it still needs some improvement like retention and enrollment of students in education. The drop-out problem is a major in India. During this pandemic situation, drop-out problems become a significant issue. Researchers introduced a theory called the six sigma theory to reduce the rate of drop-out students. The goal of the six sigma theory is zero defects (zero drop-out), which means every student can learn or benefit from education and get motivated until the fulfilment of their needs. DMAIC is one of the pedagogical and instructional processes that helps reduce time and cost and retain students at school. The main aim of this framework developed by the researcher is. The researcher reviewed many research studies, and based on knowledge and critical Analysis, researcher developed this framework to satisfy students' needs and retain them in school to achieve their goals. Therefore, the researcher has applied this methodological approach to reduce the drop-out rate in India.

**Keywords:** Six Sigma Theory; Drop-out students; Quality improvement; Zero defects; DMAIC; Student satisfaction

### Introduction

At present, quality education is needed for the development of any country. Consequently, several nations, including India, are taking different measures to enhance quality. Multiple policies and programs have been changed and modified, and new policies and programs are being introduced in India. Recently, the six-sigma theory has been developed as a practical approach to improving the quality of education in the world and India. But dropping out is a significant barrier to quality improvement in India. Drop-out means a student leaves the school after studying few days at school. In recent times, the number of drop-out students in India has increased. In 2017-18, the National Sample Survey Organization's household survey reported 3.22 crore out-of-school children (6-17 years) in India. The drop-out rate in India was much lower than earlier (near less than 3%) in the first half of the 2020 year. But after the COVID-19 pandemic, this drop-out rate may increase due to the loss of jobs and economic crisis. According to government data, the drop-out rate increases after class viii. Also, data showed that in 2016, the drop-out rate was the highest, at about 18%. In India, only 70% of students finish school education. (M. & Sekher, 2014)

The Government of India has taken many steps to reduce the number of schools drop-outs. In conjunction with State Governments, the Central Government is conducting several education-development programmes. The GOI (Government of India) introduced various strategies and planned to reduce them like Sarva Shiksha Abhiyan, Right

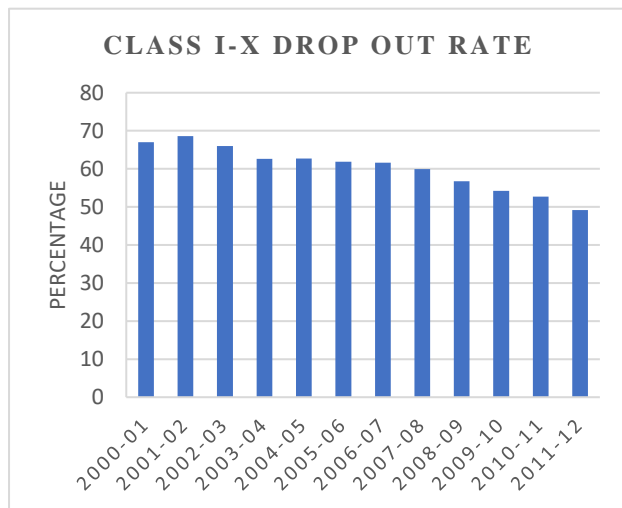
to Education act 2009, the Kasturba Gandhi Balika Vidyalaya schemes, Mid-Day-Meal schemes and so on (Singh, 2018). Various states are taking into consideration this matter. Different national policies developed after independence to improve the quality of education in India, like-1968 policy, the 1986 policy, 2020 new education policy, also emerged to solve this type of problem (Aithal & Aithal, 2020). The six-sigma theory can be helpful for the policymaker, and contributors, to improve the overall quality of education and reduce the problems. Therefore, the researcher defines the six sigma theory and reviews various articles, literature, journals, and documents related to this issue (Tjahjono et al., 2010).

**Concept of Six Sigma:** The Motorola company introduced the idea of six sigma in the 1980s. Six Sigma is a data-driven approach, a set of techniques to remove defects from processes and products in the organization. Six sigma is also a philosophical idea applied to management and organization setup. The main aim of the six sigma theory is to limit the defects. The main principle of this theory is customer focus. This theory focuses on customer satisfaction and reducing cost. The other functions of this theory are eliminating waste, reducing process variability, increasing customer satisfaction, reducing cost, increase good quality output. The researcher did various reviews and made a statement ((PDF) Understanding Basics of Six Sigma, n.d.).

## Literature Review

Q. H. Mazumdar (2014) conducted research entitled as "applying six sigma in higher education quality improvement." In this study, the researcher wants to determine how six sigma can be used at higher education levels to improve quality. Here researcher considers some principles of six sigma like-process improvement, reducing waste, continuous improvements etc. Researcher used statistical process control and developed some models for the teachers and administrators to improve the education system. (Mazumdar, 2014)

Paul G. LeMahieu, Lee E. Nordstrom, Elizabeth A. Cudney (2017) conducted research entitled "Six Sigma in education." In this study, the researcher wants to find out different approaches to quality improvement in education. Here researcher gave some theoretical outputs to progress in education. This study's primary purpose was to reduce variability, reduce cost, and eliminate activity that does



The drop-out rate in India (primary-secondary level):  
Source: Government of India (data.gov.in)

not add value to desired outcomes. The result of this study revealed that it provides students' satisfaction levels and six sigma used as methodological purpose to improve quality in the organization and educational institution (Sunder M & Mahalingam, 2018).

S.L. Ho, M. Xie, T.N. Goh (2006) conducted research entitled "Adopting Six Sigma in higher education: some issues and challenges." This study aims to apply the six sigma framework in a higher education institution and to find out some challenges and issues to implementing this framework for the workers, staff, etc. In this study, an operational amplifier circuit analysis from an electrical engineering course was utilised to demonstrate that the Six Sigma framework provides an ideal foundation for incorporating statistical teaching into engineering curricula. (Ho et al., 2006).

S.K. Gupta, J. Antony, F. Lacher and J. Douglas (2020) conducted research on "Lean Six Sigma for reducing student drop-outs in higher education – an exploratory study." This study examined the probable reasons of student dropouts in higher education institutions (HEIs)

and discovered the effectiveness of Lean Six Sigma (LSS) technologies in lowering dropout rates. The researcher gathered 12 samples and performed semi-structured interviews with university personnel (n = 9) and LSS specialists (n = 3) to understand the complexity of the student drop-out phenomena and the function of various LSS instruments in lowering dropout rates. Utilizing theme analysis, researchers conduct research. This study showed that LSS is an influential framework for reducing the drop-out rate among students (Gupta et al., 2017).

## Statement of the problem

The above studies revealed a wide knowledge gap in this area. Research showed that the Six sigma theory highly impacts the education sector. But researcher wanted to apply the various methods and principles of the six sigma theory to reduce drop-out rates among school-going children in India. The researcher developed a theoretical framework to identify and reduce this problem through developing this framework.

## Objectives of the study

The purpose of the study is to apply the framework of the six sigma theory developed by the researcher based on the methodological approach of six sigma (DMAIC). Research also provides a theoretical concept to the education field that increases education quality.

## Drop-Out Students

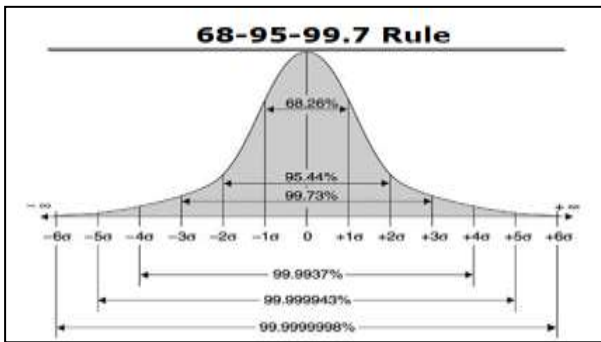
In India, Education for all schemes started in 2000, and the main aim is 100% literacy. Other objectives of SSA are Universal Enrollment, Universal Retention and so on. So, therefore we see that there are so many plans, programs, schemes, and steps taken by the Government, but lack of proper implantation, drop-out at the school cannot be controlled. There are so many states in India where the drop-out rate is much higher.

In 2016, the drop-out rate in India at the secondary level was the highest than at the primary level (17.06%). Recently United Nations announced that almost 24 million children might drop out of school due to COVID-19. Statistics showed that less than 60% of students could complete school education. Therefore, the researcher decided to use the six sigma theory considering this issue (Coronavirus Disease (COVID-19): Schools, n.d.).

## The framework of six sigma

Literally, there is no possibility of achieving 100% efficiency. Six sigma means zero defects. Here researcher introduced six sigma to achieve high efficiency. Statistically, six sigma (6 $\sigma$ ) equals 99.99966%, representing 3.4 defects per million. Six Sigma refers to the six standard deviations from a normal distribution or bell-shaped curve's mean. Utilizing the measurement of elements in a process, it strives to improve output by continually enhancing the system and its operations. Total area to the right and left of +6 and -6, respectively, represents the flaws in a Six Sigma process. (Navas et al.,

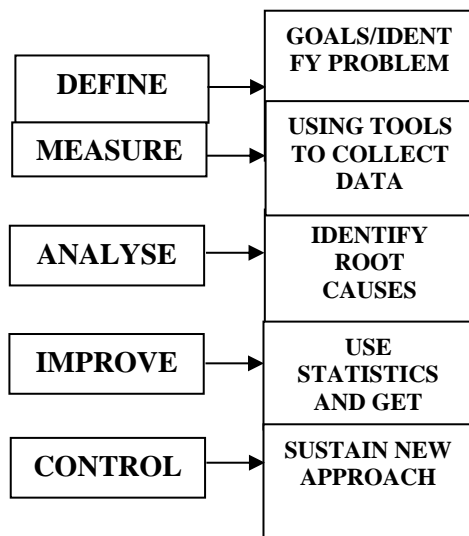
2016).



Source: article of Ramana PV

Six sigma is a methodological and statistical approach to producing good quality output and reducing defects in the system. One of the methodologies of the six sigma theory is DMAIC. It is an abbreviation for Define, Measure, Analyse, Improve, Control (de Mast & Lokkerbol, 2012).

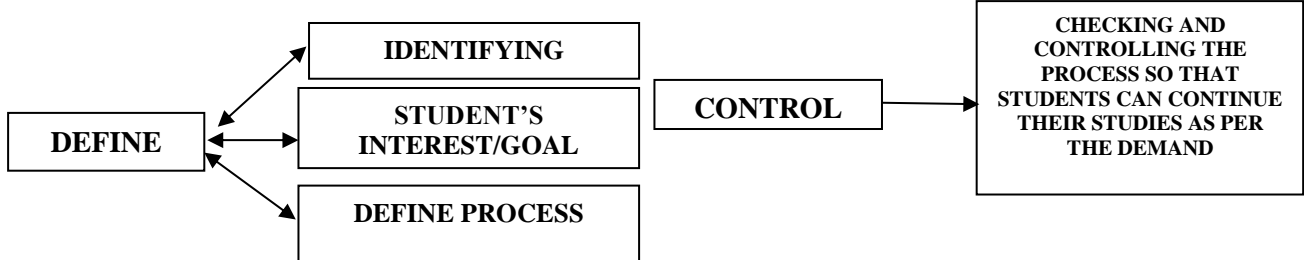
The researcher developed a framework for the students to satisfy their needs and achieve desired outcomes.



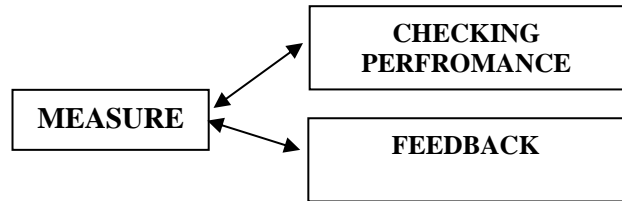
Applying DMAIC to reduce the drop-out rate: A classic problem-solving approach is DMAIC. It helps to solve existing problems and helps to reduce cost or time. It also resolves defected issues or derivation from the target/goal.

DMAIC was designed to identify a problem, improve the situation and regain control of any system.

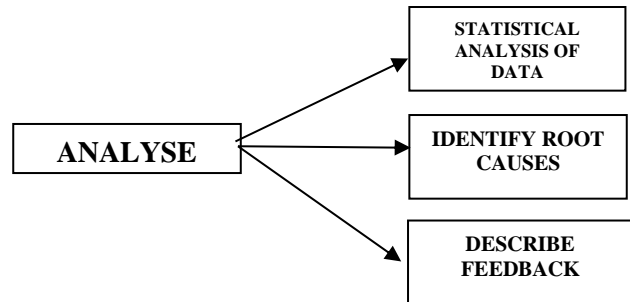
The first stage of this process is defining or setting a goal/educational objective and defining the student's needs and interests.



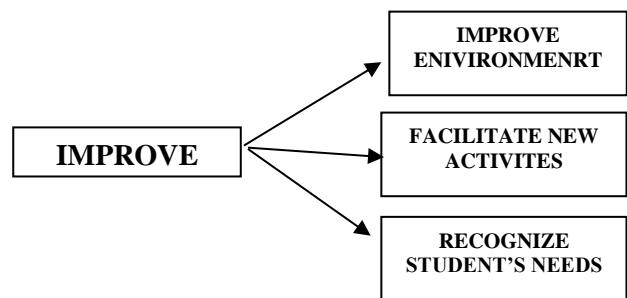
The second stage of this process is measurement. Here teacher collects the data from the student. Apply the concept of VOC (voice of customer) in education to take feedback from the students about the current procedure through various tools and techniques.



The third stage of this process is Analysis. After getting feedback from students, we need to Analysis what factors have emerged as the primary cause. Analysis reveals that problems are being created to achieve the desired goals in education. Identify some of the factors that hinder students from achieving goals.

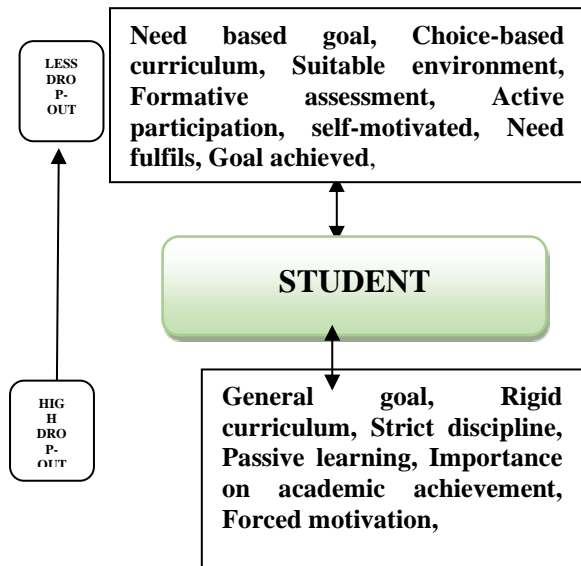


The fourth stage of this process is Improve. After analyzing the data, the next step is to solve the problems. Improvements have been made based on the previously identified root causes (through Analysis).



The last stage of this process is control. Control is nothing but sustaining the systems and stable the process. Student's gradually fulfil their needs and get interested in studying at a higher level.

This framework considers a need-based and student-based education system. Every learner can learn according to their needs and knowledge. They must actively participate in the learning process, which should be the motto of any education system. Students learn constructively and retain in the system.



### Conclusion

Here researcher provides a general framework for the teachers, administrators, education providers, and trainers to deliver effective education to the learner so that the drop-out rate can be less. An uninteresting curriculum, one-way communication, passive learning, and rigid system can demotivate the student. Learning is always purposeful and acquired. Based on this principle, education should be interesting and learner-centered. Six sigma theory determine educational and learner's goal (LeMahieu et al., 2017). It measures the learner's performance and identifies the problems to attain this goal (Weber, 2013). This framework analyses the problems statistically and helps to improve or change the instruction and process. Lastly, it controls the situation. Therefore, the researcher wanted to express that six sigma can effectively reduce the drop-out rate in the education system. Six sigma is a systematic process and focuses on that every learner can continue education until the fulfilment of their goals. It basically increases efficiency. Earlier studies showed that DMAIC is used as a methodology in education. Research revealed this approach improved learning efficacy and academic performance. (Kaja Bantha Navas, 2016), (Hargrove & Burge, 2002) In the present study, researchers conclude that this framework may help provide good quality education to the students. Therefore, they can stay motivated in the process of long term learning, "and the drop-out rate will be reduced.

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### References

- Q. H. Mazumdar, 360 degrees of engineering education. University of Michigan, 2014.
- Aithal, S., & Aithal, S. (2020). Analysis of the Indian National Education Policy 2020 towards Achieving its Objectives. 5, 19–41. <https://doi.org/10.5281/zenodo.3988767>
- Coronavirus disease (COVID-19): Schools. (n.d.). Retrieved May 24, 2022, from <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19-schools>
- de Mast, J., & Lokkerbol, J. (2012). An analysis of the Six Sigma DMAIC method from the perspective of problem solving. *International Journal of Production Economics*, 139(2), 604–614. <https://doi.org/10.1016/j.ijpe.2012.05.035>
- Gupta, S., Antony, J., Lacher, F., & Douglas, J. (2017). Lean Six Sigma for reducing student drop-outs in Higher Education – an exploratory study. *Total Quality Management and Business Excellence*, 31. <https://doi.org/10.1080/14783363.2017.1422710>
- Hargrove, S. K., & Burge, L. (2002). Developing a six sigma methodology for improving retention in engineering education. *32nd Annual Frontiers in Education*, 3, S3C-S3C. <https://doi.org/10.1109/FIE.2002.1158694>
- Ho, S. L., Xie, M., & Goh, T. (2006). Adopting Six Sigma in higher education: Some issues and challenges. *International Journal of Six Sigma and Competitive Advantage*, 2. <https://doi.org/10.1504/IJSSCA.2006.011564>
- LeMahieu, P. G., Nordstrum, L. E., & Cudney, E. A. (2017). Six Sigma in education. *Quality Assurance in Education*, 25(1), 91–108. <https://doi.org/10.1108/QAE-12-2016-0082>
- M., S., & Sekher, T. V. (2014). Factors Leading to School Drop-outs in India: An Analysis of National Family Health Survey-3 Data. *International Journal of Research & Method in Education*, 4, 75–83. <https://doi.org/10.9790/7388-04637583>
- Navas, R., Akash, R., Sathish, G., & Azharudeen, J. M. (2016). Six Sigma in Education: Examination Result Analysis Using Six Sigma - A Case Study. 2016 IEEE 4th International Conference on MOOCs, Innovation and Technology in Education (MITE). <https://doi.org/10.1109/MITE.2016.056> (PDF) Understanding basics of Six Sigma. (n.d.). Retrieved May 24, 2022, from [https://www.researchgate.net/publication/341880676\\_Understanding\\_basics\\_of\\_Six\\_Sigma](https://www.researchgate.net/publication/341880676_Understanding_basics_of_Six_Sigma)
- Singh, B. (2018). Different Schemes Launched by the Government for Achieving the Aims of Universalization of Elementary Education. *Journal of Advances and Scholarly Researches in Allied Education*, 15(3), 228–233. <https://doi.org/10.29070/15/57499>

- Sunder M, V., & Mahalingam, S. (2018). An empirical investigation of implementing Lean Six Sigma in Higher Education Institutions. *International Journal of Quality & Reliability Management*, 35, 2157–2180. <https://doi.org/10.1108/IJQRM-05-2017-0098>
- Tjahjono, B., Ball, P., Vitanov, V. I., Scorzafave, C., Nogueira, J., Calleja, J., Minguet, M., Narasimha, L., Rivas, A., Srivastava, A., Srivastava, S., & Yadav, A. (2010). Six Sigma: A literature review. *International Journal of Lean Six Sigma*, 1, 216–233. <https://doi.org/10.1108/20401461011075017>
- Weber, M. N. (n.d.). Lean-Six-Sigma methods for applied technical college courses [Ed.D., Edgewood College]. Retrieved May 24, 2022, from <https://www.proquest.com/docview/1759043792/abstract/72684C372FB14D13PQ/1>