



INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES



The Six Sigma Approach Improves Teacher Instruction Quality Through Quadruple Helix Model Expectations

Siti Hannah Sabtu, Mohd Effendi @ Ewan Mohd Matore, Siti Mistima Maat

To Link this Article: <http://dx.doi.org/10.6007/IJARBSS/v13-i4/16679>

DOI:10.6007/IJARBSS/v13-i4/16679

Received: 08 February 2023, **Revised:** 11 March 2023, **Accepted:** 30 March 2023

Published Online: 16 April 2023

In-Text Citation: (Sabtu et al., 2023)

To Cite this Article: Sabtu, S. H., Matore, M. E. @ E. M., & Maat, S. M. (2023). The Six Sigma Approach Improves Teacher Instruction Quality Through Quadruple Helix Model Expectations. *International Journal of Academic Research in Business and Social Sciences*, 13(4), 781 – 791.

Copyright: © 2023 The Author(s)

Published by Human Resource Management Academic Research Society (www.hrmars.com)

This article is published under the Creative Commons Attribution (CC BY 4.0) license. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this license may be seen at: <http://creativecommons.org/licenses/by/4.0/legalcode>

Vol. 13, No. 4, 2023, Pg. 781 – 791

<http://hrmars.com/index.php/pages/detail/IJARBSS>

JOURNAL HOMEPAGE

Full Terms & Conditions of access and use can be found at
<http://hrmars.com/index.php/pages/detail/publication-ethics>



INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES



The Six Sigma Approach Improves Teacher Instruction Quality Through Quadruple Helix Model Expectations

¹Siti Hannah Sabtu, ²Mohd Effendi @ Ewan Mohd Matore, ³Siti Mistima Maat

¹Faculty of Education, The National University of Malaysia (UKM), 43600 Bangi, Selangor, Malaysia, ^{2,3}Research Centre of Education Leadership and Policy, Faculty of Education, The National University of Malaysia (UKM), 43600 Bangi, Selangor, Malaysia.

Corresponding Author's Email: effendi@ukm.edu.my

Abstract

The success of Six Sigma in several industries stimulates its potential to be applied in the field of education. The literature shows that there are almost no quality assessment studies in Malaysian education using the Six Sigma approach, and existing studies have only focused on the profit-driven sector. Therefore, this article aims to explain the implementation of the Six Sigma approach to assess the quality of teacher teaching and improve the quality of teaching in the classroom. This is because teacher teaching is still a challenge for the Malaysian Ministry of Education when its effectiveness towards student achievement is often questioned. The ideas in this article also discuss the expectations of the innovation-based Quadruple Helix Model for the application of the Six Sigma approach in order to assess the quality of teacher teaching. Discussion summary are expected to add value to the multiplication of existing knowledge as well as contribute to the production of a new technique and approach to assess the quality of teacher teaching using the Six Sigma approach. In addition, the Quadruple Helix Model is expected to develop ideas in order to improve and ensure that the education system in Malaysia becomes one of the best in the world.

Keywords: Six Sigma, Teaching Quality, Quadruple Helix Model, Teacher, Education

Introduction

Teachers are the most important driving force at the school level for student success (Ashwin, 2022; Bijlsma et al., 2021). Quality teachers are very important in the education system to ensure that the education process runs smoothly as desired (Almutairi and Shraid, 2021; KPM, 2018a). Since the quality of teachers is the main driving force behind the transformation process and the provision of quality education (Deti Rostini et al., 2022), a quality teacher can produce quality students, and this becomes the main factor determining student success (Olawoyin and Isuku, 2019). The higher the quality of a teacher, the higher the effectiveness in carrying out work, especially in ensuring that students acquire the highest quality of

education. Therefore, the quality of a teacher is a determinant of student success, and this has become the main objective of education reform in most countries.

Effective teaching and learning result from quality teachers (Lee, 2018). Therefore, the success of the teaching and learning process depends on the quality of teacher teaching. A lack of teacher teaching effectiveness makes the teaching and learning process problematic; as a result, students are not guided appropriately and are unable to learn (Sogunro, 2017). Besides, a teacher's inability to deliver lesson content using the correct method reduces students' learning interest. This shows that the quality of teacher teaching has a great impact on students; the higher the quality of teaching delivered to students, the greater the students' motivation to learn (Blomeke and Olsen, 2019).

Efforts to improve the quality of education have been actively implemented in most countries around the world. As such, many international educational organizations have implemented the concept of quality in the education system. For instance, Total Quality Management (TQM) or TQM methodologies such as Six Sigma, Kaizen, and Continuous Quality Improvement (CQI), including quality management systems such as National Organization for Standard (ISO) 9001, have been implemented to improve quality in education (Arokiasamy and Krishnaswamy, 2021; Goetsch and Davis, 2016; Sfakianaki and Kakouris, 2019; Soria-Garcia and Martinez-Lorente, 2014). All of these countries have also become increasingly aware of quality aspects and shown interest in implementing the concept of quality, especially after attending the World Education Forum of the United Nations Educational Scientific and Cultural Organization (UNESCO) in Dakar in 2000, which emphasized the need to improve quality education (Jung et al., 2021).

However, the challenge of producing quality teachers is a global issue that has always been a concern of policymakers in every country. As a matter of fact, it is said that the future of a country depends heavily on its education system. In this regard, as the global environment becomes increasingly challenging, each country will strive to ensure that its citizens receive a good education. This shows that each country aims for its education system to be among the best in the world (Sandu and Sharma, 2020). Accordingly, the quality of teacher teaching should be taken seriously because, while the education system has become increasingly challenging, the teaching profession is also increasingly burdened with responsibilities.

Teacher Teaching Quality Assessment

The quality of teacher teaching is the main key to student development. Empirical evidence has shown that the quality of teacher teaching affects student achievement in the sense that what students obtain depends on the efforts made by the teachers (Almutairi and Shraid, 2021; Hammond et al., 2017; Deti Rostini et al., 2022). Teachers' creative and innovative teaching practices can attract students' learning interest (Blomeke and Olsen, 2019; Lee, 2018). Therefore, the excellence of the education system requires the transfer of excellence from among its implementers, i.e., teachers. For instance, the education system must provide reliable and valid teaching assessments for the development of quality in education (Kim et al., 2019).

The determination of quality in education requires a set of assessments that are applied universally (Jamin et al., 2022). Based on empirical studies, to ensure that a satisfactory

teaching level can be established and maintained in educational institutions, most countries have standards to assess the quality of teacher teaching (AITSL, 2017; GOV.UK, 2021; KPM, 2018b; NBPTS, 2016; NCATE, 2008). Teacher teaching quality assessment is an assessment for evaluating what teachers have achieved and what teachers require in order to develop or improve their competence (Almutairi and Shraid, 2021; Kim et al., 2019). Assessments in teaching and learning are also an important requirement to evaluate and improve quality in an educational institution (Jayamohan and Bhasi, 2021). Thus, teachers must constantly evaluate and criticize their teaching practices to improve their teaching skills (Seyyed et al., 2022).

However, in real situations, most teacher assessment systems do not help improve teacher competence and teaching and learning quality (Darling-Hammond et al., 2015; Gerritsen et al., 2016). Although the assessment of teacher teaching quality is carried out by the responsible party, the results of teacher teaching quality are still the same (Callahan and Sadeghi, 2015). This is because the assessment places more emphasis on the rating of teaching and learning carried out by teachers and does not emphasize how to detect weaknesses and improve more effective teaching and learning. According to Callahan and Sadeghi (2015), the teaching and learning assessment of teachers should emphasize measuring the strengths and weaknesses of teachers as well as identifying the causes of problems and offering improvement strategies that help teachers improve the quality of teaching in the classroom.

In addition, based on the findings of the study by Bijlsma et al (2022), instruments for evaluating the quality of teacher teaching are limited and there is no standard teacher quality measurement instrument that can be used to assess teacher quality worldwide. In fact, there are various opinions and contradictions in evaluating the quality of teacher teaching. For instance, the assessment of the teaching quality of teachers is not fully linked to teaching ability (Darling Hammond et al., 2017). Although there are studies evaluating the quality of teaching abroad, the findings of these studies focus more on measuring the quality of teaching in Higher Education Institutions (HEIs) (Ashwin, 2022; Ekawati et al., 2022; Maclel-Monteon et al., 2020; Wang, 2022)

Six Sigma Approach in Teacher Teaching Quality

Six Sigma is a methodology in the field of total quality management (TQM) (Kamran Moosa and Ali Sajid, 2010) and a concept of quality management towards customer-oriented continuous improvement. Six Sigma is also a technique and tool for solving problems, improving results, and reducing product damage (Yu et al., 2022). Six Sigma has been used by most companies around the world, starting at Motorola in 1985 by Bill Smith, who was an engineer at the company (Pyzdek and Keller, 2018). The use of the Six Sigma approach at Motorola has successfully enhanced processes and quality control by making improvements in the process of producing optimal output by reducing waste in the company (Nuresa et al., 2022). As a result, in 1988, Motorola successfully received the first Malcolm Baldrige National Quality Award. The outstanding success achieved by Motorola has then attracted the interest of many large companies to use Six Sigma such as General Electric, Allied Signal, Texas Instruments Defense Group, International Business Machines Corporation, and Digital Electronics.

In order to improve the quality of services offered to customers, Six Sigma is an effective quality tool to be used across all fields, including education (Mazen Arafah et al., 2021). The Six Sigma approach not only benefits customers as they can enjoy quality output but also organizations, particularly through cost savings and increased operational efficiency. The success of Six Sigma in the industry has attracted the interest of scholars to apply the Six Sigma approach in the field of education (Kumar, 2015). In fact, Six Sigma has been used in the education sector since 2000 and has been successfully adopted in most fields of education (Ameen Abdulla and Kavilal, 2022). Previous studies have also proven that the Six Sigma approach can be implemented in educational institutes to improve the quality of education (Ameen Abdulla et al., 2020; Davis and Fifolt, 2018). One of the areas in education that can be improved by applying Six Sigma includes the assessment of teaching quality (Wang, 2022).

However, past analysis has shown that there is still a lack of research on the Six Sigma approach in measuring and evaluating the quality of teacher teaching. In fact, articles published using the Six Sigma approach for teaching and learning quality improvement are only for lecturers at HEIs (Al Kuwaiti and Subbarayalu, 2015; Vijay, 2013; Vijaya Sunder, 2014; Wang, 2022; Yu and Ueng, 2012). Nonetheless, Siti Hawa and Noor Raudhiah (2017) opined that the quality of teacher teaching in schools is also important and must be emphasized to ensure that the teaching and learning process runs effectively and achieves the goals set in quality education. This is because the Six Sigma approach is deemed able to help teachers identify the root of the problems encountered in implementing teaching and learning and offer continuous improvement methods to help teachers improve the quality of teaching. In addition, one of the concepts of Six Sigma according to Yu et al. (2022) and Sandu and Sharma (2020) is to eliminate the cause of the defect the Six Sigma approach is used when the cause of the problem is not found to improve a critical process. Therefore, the application of Six Sigma in schools to improve the quality of teacher teaching is appropriate.

Quadruple Helix Model Expectations

Quadruple Helix is a form of collaboration in research methods based on the triple helix concept, which is often used in research involving collaboration between academics, government, and industry for the production of new innovations (Etzkowitz and Leydesdorff, 1995; Leydesdorff, 2012). The triple helix concept began to gain attention and is increasingly growing, leading to the consideration of additional members to work together to improve efficiency and produce innovations that impact stakeholders. Hence, in 2009, Carayannis and Campbell (2009) proposed the addition of members involving the community and emphasized research towards innovation and creativity to meet social needs (Leydesdorff, 2012).

In the context of this study, the Quadruple Helix Model Expectations refer to the expectations of future innovation through the Six Sigma approach in improving the quality of teacher teaching in Malaysia, which involves the collaboration roles involving the government, Higher Education Institutions (HEIs), industry, and the community (Amar et al., 2021; Schutz et al., 2019). The involvement of the representatives involved in the research process is important to create new innovations, namely the use of the Six Sigma approach in evaluating the quality of teacher teaching, which ultimately has a great benefit and impact on the education sector and all stakeholders involved.

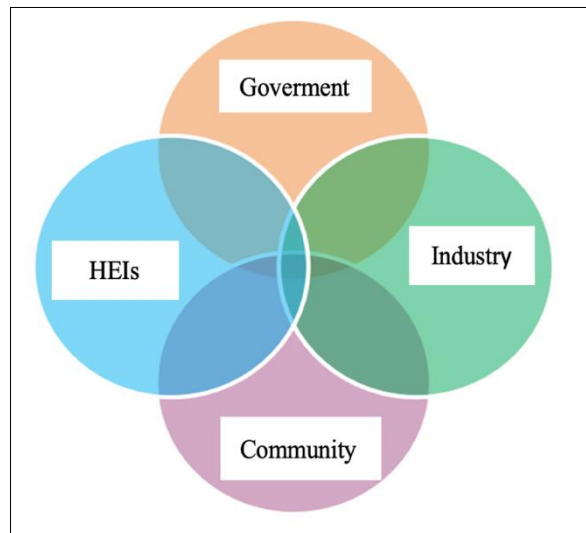


Figure 1: Quadruple Helix Model Expectations in Education

First, strategic collaboration with the government involves the role of the Ministry of Education Malaysia and the Ministry of Higher Education Malaysia to confirm the conceptualization and operationalization of teaching quality indicators through Six Sigma so that the assessment carried out is valid and can improve the quality of teacher teaching whilst achieving the goal of quality education. Accordingly, aspects of the conceptualization and operationalization of teaching quality indicators through Six Sigma must be refined and better analyzed because their use in education is still vague. Therefore, there is a high need for the concept to be confirmed and validated with expert consultation from professionals in the field of education.

Second, the strengthening of a teacher teaching quality assessment using Six Sigma is aimed at collaborative collaboration with HEIs involving lecturers from the fields of education, quality, as well as measurement and evaluation. As a result, this collaboration will help researchers generate ideas, especially in terms of efforts that can be implemented using the Six Sigma approach to improve skills and the quality of teaching among teachers. Indirectly, these efforts necessarily support the goal of the Malaysian education system to produce world-class quality teachers, particularly in realizing the aspiration of increasing student success to be on a par with other countries at the international level (KPM, 2013, 2018a).

Third, the empowerment of collaborative involvement from practitioners or industry experts can expand the implementation of the Six Sigma approach in the education sector. Since the implementation of the Six Sigma approach in the field of education in the Malaysian context has yet to be widespread, the education sector lacks Six Sigma experts in education, thus presenting a challenge in its implementation. Therefore, the joint involvement of the industry will add value to the proliferation of existing knowledge of the Six Sigma implementation concept to enhance the excellence of education, especially in the quality of teacher teaching.

Fourth, the community's contribution to improving the quality of teacher teaching using the Six Sigma approach is also crucial. In the context of this study, students are customers of educational institutions and they have needs to be met (Paricio Royo, 2017). The satisfaction desired by students includes satisfaction with the quality of teacher teaching, which is related

to factors such as competence and skills in handling the teaching process in the classroom (Olawoyin and Isuku, 2019; Wang, 2022; Yu and Ueng, 2012). Thus, the community plays a role in supporting the new needs of teachers in improving their professionalism. Involvement from the community that creates a learning ecosystem that achieves quality standards will also meet the main concept of Six Sigma, which is to satisfy customer needs.

Therefore, to improve the quality of teacher teaching, the use of the Six Sigma approach is necessary to detect the strengths and weaknesses of teaching. Six Sigma is one of the good quality improvement methods for the improvement process in the field of education (Maclel-Monteon et al., 2020; Arafeh et al., 2021). The innovation of teacher assessment using the Six Sigma approach is a creative innovation where new assessment methods are used for stakeholders to assess the quality of teacher teaching more comprehensively. The discovery of innovation using the Six Sigma approach in improving and dealing with the problems encountered can also improve the quality of education in Malaysia. The innovation produced entails an effort to change the learning process, produce more creative teaching, and improve the quality of teacher professionalism.

Conclusion

The assessment of teacher teaching quality using the Six Sigma approach is expected to produce reform in the education sector, especially in the field of measurement. Collaboration using the Quadruple Helix Model involving the government, HEIs, industry, and community will help researchers develop, create, and commercialize the idea of using Six Sigma in education. As a result, the Malaysian education system will be known as a global education hub that has its own special features and provides values-driven education. This discussion

insightfully contributes to several main points. First, the current study adds value to the existing literature and knowledge of the Six Sigma approach in the education sector as well as fills the research gap in the production of new assessments, particularly in assessing the quality of teacher teaching using the Six Sigma approach. Second, the implementation of Six Sigma based on the culture and context of Malaysian government schools provides an opportunity for scholars to explore and develop the potential of Six Sigma through more effective strategies in different institutional contexts. Third, teachers can improve self-competence and teaching quality using the Six Sigma approach by providing guidelines to plan appropriate interventions. Fourth, stakeholders can diagnose the issues related to teacher teaching in detail in order to plan specific interventions to improve the quality of teacher teaching. Fifth, this study provides new insights that will provide benefits and implications to the theory, the field of measurement, and the implementation of the Six Sigma approach in education in Malaysia, particularly for the Malaysian Ministry of Education. The implementation of the Quadruple Helix Model through the Six Sigma approach in improving the quality of teacher teaching in Malaysia will also strengthen the cooperative relationship between the government, HEIs, industry, and the community, besides directly impacting the stakeholders to achieve the goals set in quality education. Finally, the Quadruple Helix model will help the country's education sector to achieve double-leap success in improving the quality of teacher teaching using the Six Sigma approach. Other than providing benefits and rights collectively, the transformation of teacher teaching assessment using Six Sigma will also provide each stakeholder with an appropriate role in ensuring a world-class education system.

Recommendations

Further research is recommended for relevant parties to conduct effectiveness studies by exploring more aspects of Six Sigma in the education sector, particularly school management. Researchers can further develop the ideas from this concept paper by extending the Six Sigma approach in various fields of education in different institutional contexts. Indeed, the implementation of the Quadruple Helix Model through Six Sigma in improving the quality of teacher teaching in Malaysia is crucial for the diversity of processes in education. Therefore, such integrated cooperation should be developed to achieve a quality education system.

Acknowledgment

I would like to acknowledge and express my gratitude to my supervisor, Associate Professor Ts. Dr. Mohd Effendi @ Ewan Mohd Matore and Associate Professor Dr. Siti Mistima Maat for their relentless contribution to this study. I am also immensely thankful to my family and friends for their continuous support and understanding when writing this review paper.

References

- Arokiasamy, A. R., & Krishnaswamy, J. (2021). Compatibility and Challenges of Implementing Total Quality Management in Education. *Proceeding on Engineering Sciences*, 405–411.
- Abdulla, A., & Kavilal. (2022). Analytical Investigation of Higher Education Quality Improvement by Using Six Sigma Approach. *HighTech and Innovation Journal*, 3(2), 196–206. <https://doi.org/10.28991/hij-2022-03-02-07>
- Abdulla, A., Navas, M., Amal, & BismilNizam. (2020). Quality Assurance in Education Based on Six Sigma Tool. *Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE*, 2347–2360.
- AITSL. (2017). *The Australian Institute for Teaching and School Leadership*. <https://www.aitsl.edu.au>
- Al Kuwaiti, A., & Subbarayalu, A. V. (2015). Appraisal of Students Experience Survey (SES) as a Measure to Manage The Quality of Higher Education in the Kingdom of Saudi Arabia: An Institutional Study Using Six Sigma Model. *Educational Studies*, 41(4), 430–443. <https://doi.org/10.1080/03055698.2015.1043977>
- Almutairi, T. S., & Shraid, N. S. (2021). Teacher Evaluation by Different Internal Evaluators: Head of Departments, Teachers Themselves, Peers and Students. *International Journal of Evaluation and Research in Education*, 10(2), 588–596. <https://doi.org/10.11591/ijere.v10i2.20838>
- Amar, M. S. S., Nordin, S., Ismail, I., Abdul Hadi, S., & Arifin, A. M. I. (2021). Quadruple Helix Approach on Education Stem-Based Corporate Social Responsibility (CSR). *SHS Web of Conferences*, 124, 07004. <https://doi.org/10.1051/shsconf/202112407004>
- Amirian, S. M. R., Ghaniabadi, S., Heydarnejad, T., & Abbasi, S. (2022). The Contribution of Critical Thinking and Self-Efficacy Beliefs to Teaching Style Preferences in Higher Education. *Journal of Applied Research in Higher Education*, 2(1), 1–17. <https://doi.org/10.1108/JARHE-11-2021-0441>
- Arafeh, M. (2016). Leveraging Six Sigma Tools and Methodology to Improve Student English Language Performance at Elementary School. *American Journal of Operations Research*, 6(4), 261–274. <https://doi.org/10.4236/ajor.2016.64026>
- Ashwin, P. (2022). Developing Effective National Policy Instruments to Promote Teaching Excellence: Evidence From The English Case. *Policy Reviews in Higher Education*, 6(1), 27–45. <https://doi.org/10.1080/23322969.2021.1924847>

- Bijlsma, H. J. E., Glas, C. A. W., & Visscher, J. A. (2021). Factors Related to Differences in Digitally Measured Student Perceptions of Teaching Quality. *An International Journal of Research, Policy and Practice*, 1–21. <https://doi.org/10.1080/09243453.2021.2023584>
- Blomeke, S., & Olsen, R. V. (2019). Consistency of Results Regarding Teacher Effects Across Subjects, School Levels, Outcomes and Countries. *Teaching and Teacher Education*, 77, 170–182. <https://doi.org/10.1016/j.tate.2018.09.018>
- Callahan, K., & Sadeghi, L. (2015). Teacher Perceptions of The Value of Teacher Evaluations: New Jersey's ACHIEVE NJ. *International Journal of Educational Leadership Preparation*, 10(1), 46–59.
- Carayannis, E. G., & Campbell, D. F. J. (2009). "Mode 3" and "Quadruple Helix": Toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management*, 46(3–4), 201–234. <https://doi.org/10.1504/ijtm.2009.023374>
- Darling-Hammond, L., Amrein-Beardsley, A., Haertel, E., & Rothstein, J. (2015). Evaluating Teacher Evaluation. *Kappanmagazine.Org*, Jun, 8–15. <https://doi.org/10.4324/9780203053874-32>
- Darling Hammond, L., Hylar, M. E., & Gardner, M. (2017). Effective Teacher Professional Development. In *Learning Policy Institute*.
- Davis, M., & Fifolt, M. (2018). Exploring employee perceptions of Six Sigma as a change management program in higher education. *Journal of Higher Education Policy and Management*, 40(1), 81–93. <https://doi.org/10.1080/1360080X.2017.1377970>
- Ekawati, R., Masriyah, Rosyidi, A. H., Prawoto, B. P., Prahmana, R. C. I., & Lin, F. L. (2022). Developing A Constructive Conceptual Framework Of A Pre-Service Mathematics Teachers' Content Knowledge Instrument On Space And Shape. *Multidisciplinary Digital Publishing Institute*, 10(1), 1–15. <https://doi.org/10.3390/math10010137>
- Ekhsan, S. H. R., & Bakar, N. R. A. (2017). Amalan Pengurusan Kualiti Menyeluruh Dalam Pengajaran dan Pembelajaran Melalui Kaedah QFD (Quality Function Deployment). *Malaysian Online Journal of Education*, 1(1), 12–19. <https://doi.org/10.4271/870272>
- Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix, University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development. *EASST Review*, 14(1), 14–19.
- Gerritsen, S., Plug, E., & Webbink, D. (2016). Teacher Quality and Student Achievement: Evidence From a Sample of Dutch Twins. *Journal of Applied Econometrics*, 32(3), 643–660. <https://doi.org/10.1002/jae>
- GOV.UK. (2021). *Teachers' Standards Guidance for School Leaders, School Staff and Governing Bodies*. Department for Education. <https://assets.publishing.service.gov.uk>
- Jamin, N. H., Surat, S., & Mohammad, W. M. R. W. (2022). Model Pengukuran Konstruksi Pengetahuan Guru Dalam Kemahiran Berfikir Aras Tinggi (KBAT): Analisis Faktor Pengesahan. *Malaysian Journal of Social Sciences and Humanities*, 7(2), 1–18. <https://doi.org/10.47405/mjssh.v7i2.1299>
- Jayamohan, K. G., & Bhasi, A. B. (2021). Development of a Tool for Measuring Performance of Higher Educational Institutions by Applying Six Sigma Methodology in Teaching-Learning Process. *International Journal of Mechanical Engineering*, 6(3), 3525–3531.
- Jung, E., Shin, S., & Jung, E. J. (2021). Critical Success Factors for Total Quality Management in Primary and Secondary Education. *International Journal of Services and Operations Management*, 40(4), 564–593. <https://doi.org/10.1504/IJSOM.2021.120061>
- Kaiseroglou, N., & Sfakianaki, E. (2020). A Review of Total Quality Management Applications in Schools. In *International Journal Management in Education*, 14(2), 121-134

- Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st Century Teaching skills: The Key to Effective 21st-Century Learners. *Research in Comparative and International Education*, 14(1), 99–117. <https://doi.org/10.1177/1745499919829214>
- KPM. (2013). *Pelan Pembangunan Pendidikan Malaysia 2013-2025 (Pendidikan Prasekolah hingga Lepas Menengah)*. Kementerian Pendidikan Malaysia.
- KPM. (2018a). *Pelan Pembangunan Pendidikan Malaysia 2013-3025: Laporan Tahunan 2018*. Kementerian Pendidikan Malaysia.
- KPM. (2018b). *Standard Kualiti Pendidikan Malaysia Gelombang 2 (SKPMg2)* (3rd Edition). Kementerian Pendidikan Malaysia.
- Kumar, N. (2015). Six Sigma in Education System : A Review. *International Journal for Scientific Research & Development*, 3(03).
- Lee, S. W. (2018). Pulling Back the Curtain: Revealing the Cumulative Importance of High-Performing, Highly Qualified Teachers on Students' Educational Outcome. *Educational Evaluation and Policy Analysis*, 40(3), 359–381. <https://doi.org/10.3102/0162373718769379>
- Leydesdorff, L. (2012). The Triple Helix, Quadruple Helix, ..., and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy? *Journal of the Knowledge Economy*, 3(1), 25–35. <https://doi.org/10.1007/s13132-011-0049-4>
- Maclel-Monteon, M., Limon-Romero, J., Gastelum-Acosta, C., Tlapa, Di., Baez-Lopez, Y., & Solano-Lamphar, H. A. (2020). Measuring Critical Success Factors for Six Sigma in Higher Education Institutions: Development and Validation of a Surveying Instrument. *Institute of Electrical and Electronics Engineers Access*, 8(1), 1813–1823. <https://doi.org/10.1109/ACCESS.2019.2962521>
- NBPTS. (2016). *National Board for Professional Teaching Standards: The Five Core Propositions*. 10–12. http://www.nbpts.org/the_standards/the_five_core_propositio
- NCATE. (2008). Professional Standards for the Accreditation of Teacher Preparation Institutions. In *National Council for Accreditation of Teacher Education*. <https://doi.org/10.1136/bmj.2.6044.1133-d>
- Nuresa, R., Khosi'in, E. M. A., & Febriyani, A. R. (2022). Penerapan Prinsip Six Sigma Dalam Membangun Manajemen Mutu Pendidikan Islam. *Jurnal Manajemen Pendidikan Islam*, 6(2), 295–306. <https://doi.org/10.32478/evaluasi.v6i2.1052>
- Olawoyin, M. A., & Isuku, E. J. (2019). Students' Academic Achievement as Influenced by Teachers' Quality: Evidence From Southwest, Nigeria. *European Journal of Education Studies*, 6(7), 52–66. <https://doi.org/10.5281/zenodo.3477663>
- Paricio Royo, J. (2017). Students as Customers: A Paradigm Shift in Higher Education. *Journal on Culture, Power and Society*, 2, 137–150. <https://doi.org/10.28939/iam.debats-en.2017-10>
- Pyzdek, T., & Keller, P. (2018). *The Six Sigma Handbook A Complete Guide for Green Belts, Black Belts and Managers at All Levels* (5th Editio). McGraw Hill Education.
- Sandu, A. S., & Sharma, P. (2020). Implementation of DMAIC Methodology of Six Sigma in Vocational Education and Training for Quality Improvement. *International Journal of Advance Research and Innovation*, 8(4), 297–301. <https://doi.org/10.13140/RG.2.2.19687.68001>
- Schutz, F., Heidingsfelder, M. L., & Schraudner, M. (2019). Co-Shaping the Future in Quadruple Helix Innovation Systems: Uncovering Public Preferences toward Participatory Research and Innovation. *The Journal of Design, Economics, and Innovation Volume*, 5(2), 128–146. <https://doi.org/10.1016/j.sheji.2019.04.002>

- Sfakianaki, E., & Kakouris, A. (2019). Lean Thinking for Education: Development and Validation of an Instrument. *International Journal of Quality and Reliability Management*, 36(6), 917–950. <https://doi.org/10.1108/IJQRM-07-2018-0202>
- Sogunro, O. A. (2017). Quality Instruction As A Motivating Factor In Higher Education. *International Journal of Higher Education*, 6(4), 173–184. <https://doi.org/10.5430/ijhe.v6n4p173>
- Soria-Garcia, J., & Martinez-Lorente, A. R. (2014). Development and Validation of a Measure of the Quality Management Practices in Education. *Total Quality Management and Business Excellence*, 25(1), 57–79. <https://doi.org/10.1080/14783363.2011.637790>
- Vijay, A. (2013). Appraisal Of Student Rating As A Measure To Manage The Quality Of Higher Education In India: An Institutional Study Using Six Sigma Model Approach. *International Journal for Quality Research*, 7(3), 307–321.
- Vijaya Sunder, M. (2014). Quality Excellence in Higher Education System Through Six Sigma: Student Team Engagement Model. *International Journal of Six Sigma and Competitive Advantage*, 8(3–4), 247–256.
- Wang, Q. (2022). Application of Six Sigma Management-based Teaching Method in Financial Management Course Online Teaching. *International Journal of Emerging Technologies in Learning*, 17(1), 60–73. <https://doi.org/10.3991/ijet.v17i01.28269>
- Yu, C. M., Huang, T. Y. H., Chen, K. S., & Huang, T. Y. H. (2022). Construct Six Sigma DMAIC Improvement Model for Manufacturing Process Quality of Multi-Characteristic Products. *Mathematics*, 10(5), 1–13. <https://doi.org/10.3390/math10050814>
- Yu, K. T., & Ueng, R. G. (2012). Enhancing Teaching Effectiveness by Using The Six-Sigma DMAIC Model. *Assessment and Evaluation in Higher Education*, 37(8), 949–961. <https://doi.org/10.1080/02602938.2011.592933>