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Evaluating the Role of Technology in Implementing Total Quality Management in High Schools

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Abstract: The total quality management (TQM) is a management practice based on the idea of continuous quality improvement of an organization's products and services, identifying and eliminating problems right from the root, with the participation of all members. For an educational institution, TQM can improve the quality of education, help with the learning process, provide an atmosphere with less risk of inadequate decisions, and many more. In educational institutions, the implementation of TQM is the responsibility of process approach, management responsibility, customer focus, and continuous improvement. Specifically, digital infrastructure, digital technology, and digital capabilities affect TQM practices directly. This article provides a synthesis and analysis of findings from 51 international publications on the implementation of TQM in secondary schools. This study revealed that more than the commonly stated advantages, addressing the soft facets including student/stakeholder contentment, leadership, continuous enhancement of processes and systems, teacher coaching, and effective use of technology are critical elements for successful implementation of TQM. In addition to that educational managers have to make an espousal to TQM as an omnibus management philosophy, as a supportive culture and enabling the involvement of all stakeholders.

Keywords: total quality management, secondary education, educational management, digital infrastructure, educational technology

1. Introduction

Total quality management (TQM) is a holistic management technique designed to engage all individuals within an organization in the advancement process, including one that utilizes customer satisfaction [1]. Today, TQM is increasingly being viewed as a source of strategic capabilities that can influence the organizational performance and sustained competitive advantage [2]. The main requirement from this philosophy goes beyond perceived quality by customers, as it covers all the key requirements to please the customer [3].

TQM concept has a lot of advantages in the field of education in terms of education quality and enhancing the interest of the student in their learning process. This exploratory study processes TQM in secondary schools, further exploring the following research questions: (1) How can TQM principles be applied to enhance quality in secondary schools? (2) How can TQM be effectively implemented in secondary schools? (III) What are the problems and the constraints in the TQM implementations?

To provide an overview of the use of technology (digital infrastructure, digital technology, digital capabilities) and TQM in secondary schools, it is essential to consider the interplay between these elements based on the available references. Digital infrastructure, encompassing hardware, software, networks, and data storage systems, plays a critical role in integrating information communication technology (ICT) tools like School Management Information Systems to enhance administrative efficiency in secondary schools [4]. Adequate and quality digital infrastructure, coupled with a school climate open to innovation, can motivate teachers to adopt innovative pedagogies, including the use of ICT for teaching and learning processes [5].

Digital technology tools, such as learning management systems and educational apps, can enhance teaching and learning processes, contributing to continuous improvement and promoting teamwork among school departments. The quality of technological facilities in schools needs to be developed to promote effective educational processes and motivate teachers to use digital technology [6]. Digital capability, which includes skills, knowledge, and attitudes necessary to effectively use digital tools, is vital for successful TQM implementation in secondary schools. Mastery of digital competence by teachers allows for the use of varied and quality information to students, improving the design of resources for functional and contextual learning [7].

Adoption of TQM practices in alignment with digital tools and capabilities can create better educational standards. The benefits to customers and employees in TQM and the students and instructors are well laid out, which says TQM enables good leadership and fosters goal setting as well as improving academic performance among students [8]. In this respect, TQM application to school management and leadership with strong professionalism will be

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crucial for continuous improvement and success of our educational and management institutions [9]. Therefore, the work synergies of digital infrastructure, digital technology tools, and digital capabilities with TQM practices are fundamental to the successful implementation of technological devices in secondary schools. Technology can also play a very crucial role in enhancing the functioning of a school.

The present study reviews the international literature pertaining to the uptake of TQM in education and potential benefits, facilitators, and barriers to successful implementation. The aim is to share experience about the use of TQM in secondary schools and its repercussions on school management. To support the discussion, relevant studies and scientific literature, indexed in Scopus, WoS, EBSCO, dblp, Scilit, LearnTechLib, and Google Scholar will be used to provide comprehensive information of the study. Furthermore, the use of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) analysis method will help to support the literature analysis.

2. Literature Review

TQM is significant in improving the total quality, efficiency, and performance of educational institutes. Principles such as continuous improvement, customer focus, and employee involvement are being more widely embraced even in education in an effort to further adapt to the needs of students and other stakeholders [10, 11]. TQM is being applied in the education sector by integrating quality management into the educational institutions' governance and operational systems [12], covering all the educational activities for achieving overall organizational excellence. TQM features the usage of all workers to participate in organizational processes and systematized work with management to improve quality [13].

Educational institutions that apply TQM principles focus on continuous improvement, learner satisfaction, and empowering all members of the organization, including students, teachers, and staff [14, 15]. Implementing key success factors to promote quality improvement and elevate the overall quality of educational programs is also a central component of TQM in education [16, 17].

Leadership does play a very important role in TQM because leaders are managing the educational institutions and meeting quality standards [18]. TQM systematic application to the educational institution represents one ingredient in which we committed to quality management practices and truly take the path of educational quality improvement [19]. According to the principles of TQM, educational organizations can improve educational quality, performance, and success through the active participation of all stakeholders [20]. According to previous research, there are many factors that must be addressed and implemented in secondary schools in order to effectively ensure TQM is implemented. TQM has to do with the continuous improvement of the physical and non-physical aspects of education [21]. TQM is a management system which is embedded in the learning process; that will improve quality [22]. Nonetheless, the application and effectiveness of TQM in public secondary schools are not straightforward and straightforward phenomena in some contexts, and optimal TQM adoption would take time to be realized, which led to the variable outcomes.

For TQM to be effective at secondary schools, the barrier preventing TMQ implementation must be addressed. One such strategy to address these challenges is visionary leadership, which is intended to improve education overall. Moreover, concentrating on the soft aspects of TQM practices, including continual improvement participation, teamwork, empowerment, and leadership commitment, does have a critical impact on the effectiveness of TQM implementation in schools [23]. The commitment of top management is a critical factor to guarantee that TQM is effectively adopted [24]. For example, adapting concepts of TQM relevant to the higher-education context is important for effective implementation [25] where transformational leadership has been identified as an impactful factor on TQM implementation at higher-education sector [26].

To effectively apply technology in TQM in secondary schools, it is crucial to consider various factors highlighted in the literature. Digital infrastructure, encompassing hardware, software, networks, and data storage systems, is essential for integrating digital tools for quality management purposes [27]. Digital technology supports teaching and learning processes, especially during the COVID-19 pandemic, where it became the primary mode of educational delivery. Tools such as learning management systems, educational apps, and online resources can enhance TQM practices by facilitating communication, collaboration, and data management within schools.

Digital capacity, which includes skills, knowledge, and attitudes required to effectively use digital tools, is essential for successful TQM implementation in secondary schools [28]. Teachers and school administrators need digital literacy, competence, and a positive attitude toward technology to leverage digital resources for quality improvement initiatives. By integrating these technological factors, secondary schools can enhance their TQM practices by leveraging digital infrastructure for efficient data management, utilizing digital technology tools for teaching and learning enhancement, and developing the digital capacity of educators to effectively implement quality management strategies [29, 30]. Digital tools and infrastructure also play a crucial role in creating a framework for continuous improvement and stakeholder engagement, key elements of TQM [31].

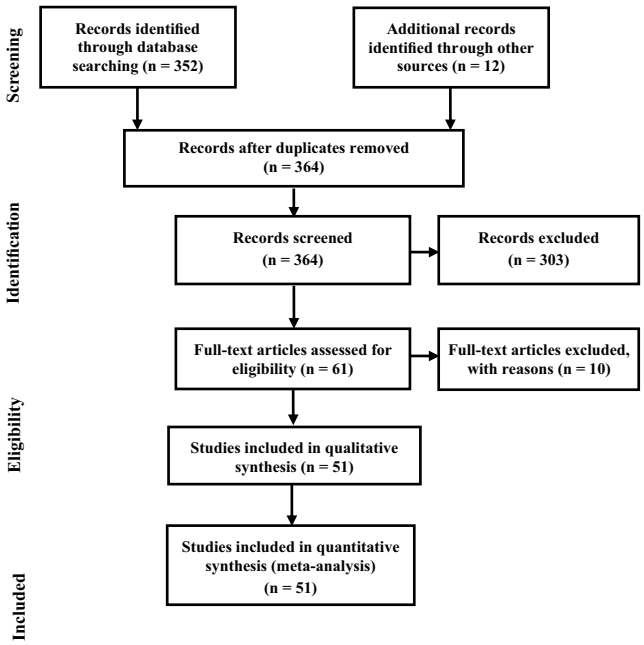
3. Research Methodology

3.1. Data collection and analysis

To obtain a comprehensive overview of the existing literature on the use of TQM in secondary schools, we conducted a systematic search and evaluation of relevant materials. We used the following keywords and keyword combinations for our literature search: "Total Quality Management", "Total Quality Management" AND "technology", "Total Quality Management" AND "Education", "Total Quality Management" AND "Secondary school", "TQM" AND "Middle school". The gathered results were further processed using the PRISMA method [32]. Our goal was to analyze the content of 51 selected articles to address our research questions (the list of the 51 articles is included in the references section). These articles met the following criteria: published in peer-reviewed academic journals; directly discussed issues related to the application of TQM in secondary schools; indexed in databases such as Scopus, WoS, EBSCO, dblp, Scilit, LearnTechLib, and Google Scholar; and written in English.

To accurately identify articles meeting these criteria, we established the following exclusion criteria: conference proceedings, books, book reviews, journals, short surveys, brief reports, correspondence, newsletters, discussions, product reviews, editorials, and publisher notes. The selected articles were then read and analyzed (Figure 1).

Figure 1
PRISMA flow diagram



We conducted searches in the Scopus, WoS, EBSCO, dblp, Scilit, LearnTechLib, and Google Scholar databases, identifying a total of 352 articles using the specified keywords and keyword pairs. An additional 12 articles were included in the study, consisting of relevant domestic publications. The screening process, which began with 364 articles, excluded 303 due to their irrelevance to education or their focus on higher education and professional education. Ultimately, 51 articles were used for content and data analysis to answer the research questions.

3.2. Findings and analysis

3.2.1. Implementation of TQM to enhance the quality of secondary education

There are some important strategies to improve the quality of secondary school education through applying TQM principles.

1) Pay Attention to the Soft TQM Aspects: Because true quality is ingrained using soft TQM aspects such as continuous improvement, teamwork, empowerment, recognition & reward, training & development, and a commitment to leadership, therefore, it creates a quality culture in the school environment. These factors significantly affect teacher job satisfaction and are important for TQM implementation in educational institutions.
2) Importance of Leadership: Leadership is an important ingredient for successful TQM implementation. School administration commitment, teacher participation, student focus, and teaching quality have been found to be important prerequisites for successful TQM. This means that quality will only be pursued and improved upon if the principals and administrators of the school will put in a cerebral commitment toward TQM in practice.
3) Training and Development: It is necessary to train teachers and staff on TQM principles. Such training will provide better quality review and improvement which will promote knowledge, regarding quality culture at school [33]. Educators and staff can be encouraged to strive for quality through ongoing training and development programs.
4) Compatibility with Existing Quality Management Frameworks: Integrating TQM with existing quality management practices like ISO 9001 and 5S principles can enhance the quality of secondary education [34]. Schools can thus integrate existing quality frameworks to make the quality improvement process more efficient by blending TQM principles with other recognized quality frameworks.

3.2.2. Principles of TQM applicable to the secondary schools

School Leadership: Implementation of TQM in educational settings, especially in secondary education, relies on the support of the school administration. A first requirement for successful implementation of TQM is commitment and capability by the leadership. It is up to school administrators to show school improvement initiatives and their commitment to a quality culture. This process may encounter resistance; therefore, it requires flexible leadership skills to implant TQM concepts into the school culture [35].

Integrate with quality management systems integration with quality management systems is essential for TQM practices to effectively improve educational quality in secondary schools. Based on this alignment, schools can enhance their procedures to ameliorate quality according to comprehensive content and thus focus comprehensively on working on instructive quality.

Foster a Quality Culture: The soft aspect of TQM, like teamwork, empowerment, and recognition, is responsible for enriching a quality culture in the environment of the school, encouraging us to collaborate, inviting teachers and staff to contribute ideas, and creating meaningfully reward systems to promote performance all nurture a sense of ownership, connectedness, and improvement in the life of your school.

Education and Training on TQM: Education and training is crucial in terms of implementing TQM at the school level. Providing necessary TQM knowledge to teachers and staff to encourage quality and enhance their awareness of the school's quality culture is significant. Continuous training and development programs will help establish mindset among teachers and staff for whom the quality in service will become a way of life and in turn participation with a spirit of inquiry can be embedded.

The latest in student satisfaction: Essential knowledge of students, parents, and community needs and expectations. It allows the design of lessons, curricula, teaching styles, and assessment techniques which are in sync with students' needs; establishing a positive, respectful, and supportive environment for learning. Collecting feedback from students, parents, and the community on a regular basis contributes to enhanced education quality [36].

It is one of our basic needs. Consistent Innovator – Always looking for new ways to be more effective in the delivery of their teaching, also be willing to try new things, adjust their actions based on what works, share what works, and learn from those around them in an attempt to drive continuous improvement.

TQM and Education: They require to attend TQM and Education and other training professional development and workshops. Thus, it is inevitable to look for advanced teaching methods and to be updated professionally, to develop soft skills like communication, teamwork, and problem-solving, and to develop leadership abilities to contribute to the development of the school [37].

Teamwork: Collaboration with peers in designing lessons, developing the curriculum, and learning through projects is key.

But when we come together to: share ideas, experiences, and knowledge with each other; encourage one another to tackle problems and brainstorm solutions; create and maintain a nurturing, engaging, and effective learning environment; all of these things help us improve the quality of education delivering in individual institutions.

TQM: Applying the principles of TQM to all teaching and learning activities, commitment to improving educational quality, and continuous participation in the quality improvement activities of the school are prerequisites for establishing a quality culture in the educational environment. These actions will enable teachers to participate in TQM principles for quality improvement in their profession.

Investing in Facilities, Equipment, and Technology: TQM will not work in the school if one does not invest on materials and also technology. This can help support TQM practices, improve the quality of educational management teaching and learning, and thus, help the students, teachers, and the school as a whole. Adequate provision of computers, interactive boards, internet access, and other ICT equipment supports online teaching and learning [38]. ICT itself will not have a big impact unless ICT confidence, attitude, and expertise are developed in teachers, thus optimizing the technology integration [39]. Access to technological resources, research centers, and libraries create a great technological learning environment [40]. Shifting toward technology such as virtual modality interactions and online learning platforms changes learning processes and connects to students and families [41]. Writing diverse library materials encourages creativity and innovation [42].

3.2.3. Technology applies to TQM in secondary schools

Technologies are significant in meaningful applying TQM for secondary schools through digital infrastructure, digital technology, and digital capability:

Quality Management Tools: Digital infrastructure must be integrated with hardware, software, networks, and data storage systems to support quality management practices.

Digital Technology Tools: Introducing school staff to digital technology tools such as learning management systems or educational apps that make teaching and learning processes more effective will foster the habit of continuous improvement as well as teamwork between school departments.

Digital capability: containing capabilities, knowledge, and attitudes required to utilize digital tools is essential for efficient TQM implementation in secondary schools [43]. Indeed, teachers and administrators also need to have digital literacy and competence to use the tech for quality improvement initiatives. According to some research, it is found that by using digitization in the education sector improves administration, resource management, and quality of reports.

Secondary schools can use technology to facilitate processes, improve communication, and allow data-driven decision-making to improve overall quality management practice. Digital infrastructure enables effective data management, while tools for digital technology facilitate teaching and learning processes, and the digital capability helps educators to successfully apply TQM practices.

3.2.4. Challenges and limitations in implementing TQM

Resistance to Change: Resistance to change from staff, students, and even parents is one of the major problems in implementing TQM. The obstacle in educational institutions is their deeply rooted traditions or practices as compared to other industries, making it more challenging for new modes of management to be implemented. Teachers might see TQM as another administrative function rather than a mechanism for enhancement. Thus, an ignorance of the TQM principles can lead to skepticism and resistance to reform initiatives [44, 45].

Absence of Organizational Leadership Support TQM Measures are applied when Support by school administrators do not in most schools where the administrators do not support or the understanding of TQM fails. As such, leaders need to drive the process through a culture of collaboration, accountability, and continuous improvement. Where top management is weak or not committed to TQM initiatives, TQM will be superficially adopted and will not be sustained over time [46].

The complexity of educational processes and the diversity of outcomes challenge the identification and subsequent measurement of quality indicators [47]. The absence of standard and objective indicators for evaluating educational quality in terms of teaching, learning, and the environment may slow down the process of monitoring its development or development of quality assurance in TQM system.

Cultural Conflict and Autonomy: Educational institutions often have hierarchical structures and rigid bureaucratic processes, which can conflict with the flexible and participatory nature of TQM. For instance, encouraging input from all stakeholders, including students and parents, may be seen as disruptive in schools where decisions have traditionally been made by administrators. Cultural norms, such as an overemphasis on standardized testing, may also misalign with TQM's holistic approach to quality. The TQM philosophy emphasizes collaboration, teamwork, and student participation, which may conflict with the culture of teacher autonomy and high professionalism. Implementing TQM processes may be perceived as infringing on teacher autonomy, leading to resistance and lack of cooperation during implementation. Staff resistance to change and reluctance to adopt new quality management practices can impede effective TQM implementation.

Resource Constraints: TQM in secondary schools requires substantial investment in training, technology, infrastructure, and professional development. The successful adoption of TQM principles may be hindered by limited financial resources, inadequate technological infrastructure, and insufficient training programs. The allocation of the necessary resources for executing TQM could prove problematic in schools [48].

Lack of Training and Knowledge: The success of TQM implementation depends on the educators and administrators themselves to have a thorough comprehension of TQM principles and practices. In Hindi – The knowledge and skills of the staff in schools will not be built unless professional development programs be conducted on TQM principles, methodologies, and tools. Staff could find it difficult in applying the principles of TQM, such as process embedding, stakeholder engagement, and utilization of data in decision-making, without proper opportunities for professional development [49].

3.2.5. Recommendations on starting TQM in secondary schools

Foster commitment from leaders: Leadership engagement is crucial to ensure the implementation of TQM. Principals and other school leaders need to articulate a clear vision for quality improvement within the context of the institutions' broader objectives. Through their behavior and involvement with quality processes, leaders can influence teachers, students, and parents to adopt TQM. Furthermore, leadership commitment helps foster a

culture of trust, collaboration, and accountability, ensuring that principles of quality permeate the school community.

Fully prepare: The preparation of teachers and staff for TQM depends on the training programs. Note that these programs should, mainly, provide a description of the TQM principles, methods, and tools and how each of the different stakeholders has a role in those processes of the quality improvement. Offer ongoing professional development to help educators learn new teaching strategies and process improvement processes. Schools may also consider providing training related to this topic area, including how to combine TQM and technology so that staff are prepared and equipped to use technology for improved management and teaching results.

Invest in digital infrastructure: Technology has a key role to play in implementing TQM and TQM can be implemented only with the help of technology. Investing in digital infrastructure (internet connectivity, hardware, and software systems) should be prioritized in secondary schools. Administrative tasks are also made easier with learning management systems, data analytics platforms, and building a data-driven decision-making specific systems. Providing sufficient technological support will allow schools to take full advantage of TQM practices, particularly those related to communication and evaluation of success.

Ensure to engage stakeholders: The engagement of stakeholders is essential to a successful implementing of TQM as this is the collective effort of everyone in the organization. Limiting involvement of those who are swimming in this with the other 788 million and their load of the program is key. Such feedback can be collected through mechanisms such as surveys, suggestion boxes, and periodic forums. Encouraging collaboration among staff and promoting team initiatives fosters a collective sense of ownership and responsibility for the quality improvement efforts.

Integrate with existing quality frameworks: Schools can strive for working with existing quality management frameworks like ISO 9001 or national education quality frameworks to ensure proper alignment and achieve maximum coherence and efficiency. Aligning with these frameworks helps coordinate quality initiatives, avoiding duplicative work and adopting tried and true best practices. This allows schools to take a holistic approach to improving quality across all aspects of the educational environment.

Encouraging continuous improvement: A fundamental principle of TQM is promoting a culture of continuous improvement. In this way, schools could regularly reassess and improve their approach to teaching, curriculum, or administration to better serve evolving needs and expectations. You are also encouraging innovation and experimentation in pedagogy; exploring new methods of teaching will allow you to discover new strategies for teaching more effectively. Data-driven insights inform schools about targeted areas of improvement that can have a real impact on both student outcomes and operational efficiency.

Train for quality: One reason for TQM shortfalls is that since employees tend to resist change, they are not trained for quality. They need to be proactive in alleviating concerns and misconceptions by opening a dialogue and clarifying how TQM will benefit the school, so that fears can be allayed. Encouraging staff as they transition to new practices and acknowledging their endeavors to embrace innovations can foster a positive atmosphere and mitigate any hesitance. In addition to this, incentives and rewards provide stakeholders with the additional motivation needed to sign on for the change and push quality initiatives.

Improving the engagement of teachers and students: The engagement of teachers and students is at the heart of TQM. Schools should embrace student-centered learning models that support diverse needs and ensure that student engagement is at the forefront of quality improvement efforts. Opportunities for professional growth are very much needed in a teacher's role, be it in the same school itself or by moving to training and workshops, adds the top leadership of several schools. This highlights the importance for schools to create a positive and inclusive environment where students and teachers alike feel valued and supported.

When looking at these key areas, secondary schools can lay the groundwork for implementing TQM properly. So, whether it's leadership, training, technological investment, or stakeholder engagement, these recommendations collectively serve as a roadmap for building a mindset of continuous improvement, one that leads to excellence in education.

4. Discussion

TQM is increasingly being proposed as an approach for secondary education, especially in the context of adopting digital technologies, but it offers opportunities and challenges. Through the studies discussed in this article, we know that TQM principles can be transformative in educational contexts – and they can be even better with the use of modern technology.

A critical insight from the literature is the significance of digital infrastructure to drive TQM initiatives. Digital tools are an essential part of school life, and they help with communication, collaboration, and data management and have become a vital part of the school ecosystem. During the COVID-19 pandemic, the technologies at the core of TQM were increasingly emphasized due to their importance for continuity of education and highlighted the absence of good digital systems necessary for the successful implementation of TQM. As Scully et al. [27] indicate, the utilization of digital instruments in quality management systems may considerably increase the effectiveness of educational service provision.

Another key component is the digital capability of teachers and administrators. Hanifah et al. [28] describe digital literacy, competence, and positive attitude toward technology as crucial for making use of digital resources in quality improvement efforts. This further emphasizes the importance of continuous professional development and training opportunities for school personnel to ensure they are well-versed in utilizing the technology.

While the positive impacts are apparent, secondary schools face limitations in realizing full TQM benefits. Barriers to such transitions include resistance to change, lack of good non-human resources, and different styles of preparing a TQM model. Kong et al. [6] highlight that compared to the TOC framework, TQM can be ambiguous and challenging in its effectiveness in certain contexts; thus, a one-size-fits-all approach should be avoided and rather, a tailored approach used in educational institutions that considers each institution's unique needs and circumstances.

This is where leadership makes all the difference. There must be visionary leader who is fully committed toward continuous improvements and is inclined toward TQM practices on both soft and hard aspects of TQM practices for proper implementation. The studies that were reviewed indicate that the commitment of the top management and transformational leadership is important in enabling and developing a culture of quality and excellence in schools [24, 26].

Additionally, Salaheldin [50] argues that TQM is a comprehensive strategy that encompasses all the CSFs and should be implemented fully, instead of implementing pieces of it

separately. The holistic theory of TQM aligns every aspect of the educational environment in pursuit of organizational excellence, ensuring a maximized impact of TQM.

TQM also improves knowledge creation and organizational performance. The role of both top and mid-level managers in precipitating TQM implementation resulting in learning and improvement culture is emphasized by Barua [51]. It highlights the need for all levels of leadership to embrace and embody TQM principles and perspective.

The factors identified by this study as critical to the implementation of TQM ideally hint that using holistic methods ensures the adoption of TQM in secondary schools, taking into account both technological and human elements. Schools can address the challenges of adopting TQM approaches by strengthening digital infrastructure, investing in digital capacity-building efforts, and fostering visionary leadership.

5. Conclusion

A unique opportunity to improve the quality of education in secondary schools is the dual implementation of TQM and technology. This study lands on finding that practical TQM implementation relies on the strategically addressing management in both technical and soft areas. Leadership is crucial, and ongoing professional development for teachers and a solid digital infrastructure are also key success factors. The need for a continuous improvement culture and stakeholder presence is paramount. TQM approach could focus on improving efficiency, efficacy to administrative components in secondary schools through digitalizing methodologies of good practice. Therefore, the transformation toward TQM practices in educational institutions is affected by top management and a clever use of technology.

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Author Contribution Statement

Pham Ngoc Son: Conceptualization, Methodology, Formal analysis, Resources, Data curation, Writing – original draft. **Nguyen Van Tam:** Data curation, Writing – review & editing.

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