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Predictors of Technological Leadership and SUC's Performance

Joshua T Soriano*

College of Science, Technological University of the Philippines, Manila, City, Philippines. *Corresponding Author's Email: joshua_soriano@tup.edu.ph

Abstract

This study investigated the influence of Total Quality Management (TQM) and Technological, Pedagogical, and Content Knowledge (TPACK) on technological leadership and institutional performance of the State Universities and Colleges (SUCs) in the Philippines' National Capital Region (NCR). Data was collected in the second quarter of 2022 through a survey of faculty and educational leaders across seven NCR SUC campuses. The research aimed to understand how these factors contribute to improve service and outcomes within the institutions. The findings revealed that TQM and TPACK are significant predictors of technological leadership performance in NCR SUCs. This suggests that universities that prioritize TQM principles and foster strong TPACK among their faculty are more likely to exhibit effective technological leadership. Furthermore, the study indicated a direct link between TQM practices and overall institutional performance, as measured by Performance-Based Bonus (PBB) indicators. While SUC E demonstrated strong performance, SUC A struggled to meet targets, highlighting the impact of TQM implementation. These results emphasize the importance of TQM in achieving institutional goals and ensuring sustainability. To maximize PBB outcomes and drive continuous improvement, university management should focus on the various dimensions of TQM. This includes fostering a culture of quality, empowering employees, and promoting data-driven decision-making. By prioritizing both TQM and TPACK, SUCs can enhance their technological leadership, improve institutional performance, and ultimately provide better service to their stakeholders.

Keywords: Educational Leaders, Performance-Based Bonus, State Universities and Colleges, Technological Leadership, Technological Pedagogical Content Knowledge, Total Quality Management.

Introduction

The Philippines National Capital Region's (NCR) State Universities and Colleges (SUCs) have a significant challenge today: ensuring that their programs continue to be accredited and obtaining Certificate of Program Compliance (COPC) set by the Commission on Higher Education (CHED). They are still having trouble cracking international university rankings and receiving performance-based bonuses (PBB) (1). This is even though they were mandated to implement a quality management system under ISO 2015 in 2016 and that continuous program accreditation is required for organizational development and SUCs leveling (2). With top management and stakeholders' support, TQM must be used to re-evaluate the institution's inputs, procedures, outputs, and feedback to meet local and worldwide standards. TQM, with the full collaboration and support of the top management and stakeholders, will be used to re-evaluate the institution's inputs, processes, outputs, and feedback to ensure compliance with local and international standards. It provides a strategy for resolving unsatisfied customers, making improvements, and preventing recurrences, as well as quality assurance that customers will receive what they want. SUCs can ensure high-quality performance in the areas of instruction, research, extension, and production services if this is put into practice. Only three of the seven SUCs in the NCR met their PBB targets from the previous academic year, according to data from the Development Academy of the Philippines (DAP) (3). It was already difficult for SUCs to maximize operations and reach their goals before the COVID-19 pandemic sparked a trend toward flexible blended distance learning and alternative working arrangements (4, 5). To create a framework for continuous improvement that can weather any crisis, the researcher must examine the TQM and TPACK of the SUCs in NCR as predictors of their institutional performance and

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technological leadership from the pre-pandemic to the new normal set-up. There is a lack of research that integrates TQM with TPACK for school leaders in the Philippines. TQM aids schools in providing high-quality education, according to past studies (6-8). Research into TPACK has centered on the methods by which educators build and incorporate technology into training programs. Both models have never been applied before to the study of technological leadership and academic excellence. Better use of technology is essential in the classroom of the twenty-first century. This change, as underlined by Serdyukov must be comprehensive, consistent, and scalable (9). To successfully prepare all students for life and work in the modern world, educators, administrators, and policymakers must innovate not only teaching and learning theory and practice, but all other parts of this complex organization as well. Our educational system will benefit from having leaders who are committed to quality and have TPACK expertise. By analyzing their TQM practices and TPACK capacities as predictors of university performance and technological leadership skills, we can better understand how to close the gaps in the provision of high-quality education in the face of the new normal, boost institutional performance, attain the performance-based budgeting goal, and bring universities up to international standards. Therefore, SUCs could evolve throughout time. SUCs in the Philippines must demonstrate technological leadership and performance if they are to make meaningful contributions to the expansion of the country's technological capacities. Using the Total Quality Management (TQM) and Technological Pedagogical Content Knowledge (TPACK) frameworks, this investigated the factors that contribute to the technological leadership and performance of SUCs in the Philippines. The goals of Total Quality Management (TQM) are to achieve 100% customer satisfaction, radical process improvement, and sustained business success. TQM has been found to be a reliable indicator of success and technological leadership in SUCs. The quality of SUCs' educational offerings, research findings, and technology innovations all improve when TQM practices are put into place (10). TQM helps HEI's achieve competitive technological leadership by promoting a culture of excellence, encouraging cooperation, and boosting overall efficiency and effectiveness (11). The TPACK framework emphasizes teachers' ability to combine their content knowledge with their pedagogical and technological expertise to better serve their students. As a result of its positive impact on classroom instruction, TPACK is a reliable indicator of technological leadership and success in SUCs. Higher rates of technology integration, student engagement, and academic accomplishment are seen in SUCs that use the TPACK framework effectively in their instructional design and delivery (12). As stated by Erlinda and Egonia, TPACK helps educators become more adept at using technology in the classroom, which in turn helps students acquire the knowledge and abilities necessary to assume positions of technological leadership at SUCs (13). To anticipate technological leadership and success in SUCs, faculty professional development plays a significant role. Effective technology integration in teaching and research is facilitated by ongoing professional development programs that aim to improve faculty members' technological abilities, pedagogical techniques, and content understanding (14). Improved technological leadership can be achieved through the cultivation of a technologically literate student body, increased research output, and new forms of innovation at SUCs through the faculty members who have received adequate training in these areas (15). A strong indicator of technological leadership and performance within SUCs is the presence of sufficient infrastructure and technology resources. Faculty and students at SUCs with cutting-edge research and innovation capabilities are supported by contemporary, well-equipped laboratories, research facilities, and access to new technology (16). The technological leadership and performance of SUCs can be improved with the help of easily accessible and up-to-date technical resources for use in teaching, research, and administrative operations (17). Predicting technological leadership and performance at SUCs also includes networks and partnerships with businesses, government agencies, and other educational institutions. Knowledge sharing, joint research projects and the transfer of new technologies all benefit from such alliances (18). Fostering technological innovation and increasing SUCs' technological

leadership, collaborative networks allow teachers and students to cooperate on real-world projects, industrial placements, and internships (19). All the mentioned literature dealt with the importance of various predictors to technological leadership and performance of higher education institutions in the Philippines which heavily relies on the leadership of administrators, thus the current study considers the investigation of TQM and TPACK of the educational leaders in NCR. This study investigated Total Quality Management (TQM) practices and Technological, Pedagogical, and Content Knowledge (TPACK) of educational leaders in selected NCR SUCs during AY 2021-2022. Specifically, it explored: firstly how respondents assess TQM practices across various dimensions (context, leadership, planning, support, operation, evaluation, and improvement); secondly how respondents assess TPACK capacities across its components (technology, content, pedagogy, technological content, technological pedagogy, pedagogical content, and TPACK); thirdly the performance level of NCR SUCs based on PBB indicators (higher education services, advanced education, research, extension, operations support, and administration); fourthly the perceived level of technological leadership across various roles (advocate, planner, leader, designer, and learner); fifthly the relationship between TQM practices, TPACK components, and institutional performance; and lastly which TQM practices and TPACK components predict technological leadership.

Materials and Methodology

Participants

The study's respondents included one hundred twenty-four (n=124) faculty members and fifty-four (n=54) educational leaders from the seven State Universities and Colleges main campuses in the National Capital Region (NCR) for the Academic Year 2021-2022 who were randomly selected. Faculty from SUCs was chosen to reply to and describe total quality management processes at their individual institutions using an adapted questionnaire checklist. Another group of respondents included educational leaders such as SUCs vice presidents, administrative officers, directors, deans, department heads and non-teaching personnel with administrative functions who described their universities' total quality management practices. Using the adapted questionnaire checklist, they were subjected to self-evaluation to describe their TPACK and technology leadership capacities. As much as the researcher hoped to obtain the desired number of respondents, the numbers may differ from the seven state universities in NCR depending on how they expressed interest and willingness to be respondents in this study.

Research Design

A descriptive non-experimental quantitative research design was utilized in the conduct of the study. This acquires quantitative data from a representative sample via surveys, questionnaires, or structured observations which is used to generalize the perception of the faculty and educational leaders (20). It is considered in the study because of the high levels of uncertainty and ignorance about the topic and the lack of recent research and literature on the research topic

Validity and Reliability of the Instrument

The predictors in the study were discerned from existing research literature, wherein the adapted instrument of the study was subjected to content and face validation of the panel experts in the field of educational management from a state university in a nearby region. Then, a reliability pilot testing was done to eleven educational leaders of the nearby state university in Region IV-A (CALABARZON). The researcher provided an electronic copy of the adopted instrument which is composed of three parts such as TQM, TPACK, and Technological leadership with a very high reliability index of 0.988, 0.962 and 0.954 respectively. The first part of the instrument about TQM practices was adapted from Santos (2021), which examined the seven dimensions of Quality Assurance (QA) management: context, leadership, planning, support, operation performance evaluation, and improvement, with six items per dimension using a four-point Likert scale and rubric. The second component of the test was derived from Depew (2015)'s study on educational leaders' TPACK capacities and consisted of nineteen items aligned to each category (21). The first-person statements have a five-point Likert scale and rubric. The last and third part, technology leadership, was adapted

from ISTE Standards for Educational Leaders (ISTE, 2018) and consisted of five dimensions: equity and citizenship advocate, visionary planner, empowering leader, systems designer, and connected learner, stated in first person using a five-point Likert scale and rubric (22).

Data Collection and Ethical Considerations

Using Google forms the data were encoded and categorized by variables, tabulated, analyzed, and interpreted using statistical methods. The Development Academy of the Philippines (DAP) website also provided university performance data for performance-based bonus indicators like higher education services, advanced education program, research program, technical advisory and extension program, support to operations, and general administrative support services for the year 2018, 2019 and 2020. The researcher requested authorization from the seven SUC presidents to collect data and distribute survey questionnaires for ethical reasons. After each SUC president approved the study, the Executive Officers of their main campuses in NCR received the approved letter. Ethical considerations included these. An informed consent letter and endorsement from the university president informed respondents about the ongoing research. Second, the researcher stated the study's goal to responders. Third, the "Informed Consent Letter" assured the University and respondents that the data obtained would be kept confidential by the researcher and the involved researcher's institution. Fourth, the researcher informed respondents that their full participation in the research may help establish a framework for NCR ongoing improvement. Fifth, the framework developed from the survey questionnaire data on TQM, TPACK, technology leadership, and SUC PBB performance indicators was presented to SUC stakeholders. The researcher said the study had no conflicts of interest. It was unfunded and the study's validator also validated the questions for free. Lastly, the author recognized potential biases, such as self-reported data, selection bias, or restricted generalizability due to sample limitations.

Data Analysis Method

Descriptive statistics, correlation, and regression analysis were used in this paper to investigate the links between elements affecting technological leadership and performance in Philippine SUCs. Descriptive statistics provide institutional and respondent profiles with baseline information. A significant link between Total Quality Management (TQM) practices, Technological Pedagogical Content Knowledge (TPACK) components, and university performance found in correlation study. Regression analysis also found which TPACK components and TQM strategies most strongly predicted technological leadership. The findings show the interconnectedness of these elements and their combined contribution to institutional outcomes, therefore stressing the need for a whole, systems-based strategy to improve technological capacities and general performance in higher education.

Results and Discussion

As reflected on Table 1, generally both the educational leaders and faculty members assessed that total quality management is much practiced by the educational leaders in the SUC's with Table 1.

Table 1: Total Quality Management Practices of Educational Leaders as Assessed by the Two Groups of Respondents

TQM Practices	Educational Leaders		Faculty Members		Overall	
	Mean	VI	Mean	VI	Mean	VI
Context of Organization	3.55	VMP	3.32	MP	3.39	MP
Leadership	3.46	MP	3.31	MP	3.36	MP
Planning	3.46	MP	3.30	MP	3.35	MP
Support	3.42	MP	3.25	MP	3.30	MP
Operation	3.38	MP	3.23	MP	3.28	MP
Performance Evaluation	3.45	MP	3.28	MP	3.33	MP
Improvement	3.18	MP	3.09	MP	3.12	MP
Grand Mean	3.42	MP	3.25	MP	3.30	MP

Over-all mean of 3.42 while faculty members reaped the overall mean of 3.25. Also, both respondents considered the context of organization as the highest aspect in which TQM is practiced with the over-all mean of 3.39 and improvement as the lowest with the over-all mean of 3.12. Table 1 presents the composite table on the total quality management practices of educational leaders as assessed by the two groups of respondents. This clearly shows that educational leaders often practice TQM in all dimensions, and the context of the organization is being given more focus to successfully deliver and strategize QMS among SUC's. It only implies that the educational leaders and faculty members are unanimous in the assessment of the TQM practices of educational leaders. The similarity in their evaluation only proves that TQM is evidently practiced ensuring quality delivery services in SUC's in the National Capital Region. As the findings show, the context of organization has the highest evaluation proving that the educational leaders considered basic methods of analysis of external factors are SWOT-analysis, PEST and PESTEL, scenario method, and of internal factors are SWOT, SMART and management analysis as they lead in implement quality management (23).

Table 2: Composite Table on the Assessment of the Respondent on the TPACK Capacities

TPACK Capacities	Mean	VI
Technology Knowledge	4.34	High Capacity
Content Knowledge	4.59	Very High Capacity
Pedagogical Knowledge	4.53	Very High Capacity
Pedagogical Content Knowledge	4.48	High Capacity
Technological Content Knowledge	4.48	High Capacity
Technological Pedagogical Knowledge	4.51	Very High Capacity
Technological, Pedagogical and Content Knowledge	4.48	High Capacity
Grand Mean	4.49	High Capacity

As shown on Table 2, most of the school leaders thought that they had high TPACK skills, with a mean score of 4.49. On top of that, subject knowledge got a mean score of 4.59, which was interpreted verbally as "Very High Capacity." The lowest score, 4.34, was interpreted verbally as "High Capacity." This shows that educational leaders agree that they have these high TPACK skills and are more aware of their subject knowledge. Some of them used to teach in the classroom before they became administrators and heads of the different programs at their separate institutions. This strong sign could be because of their past experiences. But for educational leaders to improve their technical skills, they should focus on their understanding of technology, especially as new technologies come out and their technical needs change. It means that educational leaders already have a lot of TPACK skills and can get even more by getting training in technology skills and integrating them with other TPACK skills. This could also help them figure out which technologies are best for their institution management context. Similar to Greene's study, it was found that when contextual information is added to TPACK, it is more likely that classroom elements at the micro contextual level will be addressed than at the meso or macro contextual levels (24). So, judging the TPACK of educational leaders is important so that they can make decisions that fit the needs and circumstances of their school, especially when it comes to integrating technology. Figures 1–6 show the results of the analysis of the PBB (Performance-Based Bonus) performance of SUCs in different functional areas. It is clear that there are big differences between the institutions. Notably, as compared to its counterparts, SUC E routinely performed better in the following areas: higher education services, general administrative services, support to operations, and technical advisory and extension programs. Such high results point to well-oiled institutional machinery, decisive leadership, and conformity to national benchmarks. Higher education, advanced education, research, and technical advisory programs were where SUC A performed most poorly, suggesting systemic issues like inadequate resource mobilization, inefficient governance structures, or a lack of strategic planning and

execution. A systematic and adaptive performance management framework is urgently needed to help underperforming SUCs identify gaps and implement targeted interventions. This framework should be able to handle inequalities like these. The results show that the recommendations made in this study are important, especially the one for a guiding framework that combines TQM principles with technical leadership and TPACK (Technological Pedagogical Content Knowledge). In addition to facilitating SUC-wide quality practice standardization, such a framework would lay out a strategic course for innovation, performance optimization, and continuous improvement. Further, the research suggests that benchmarking and performance monitoring should be made official to promote a culture of responsibility and high standards. Successful SUCs can teach other schools how to improve their own operations by sharing what they've learned. Together, these numbers show that SUC operations need to be managed with an evidence-based, proactive approach if we are to achieve national education goals and keep our institutions competitive through the use of strategic leadership, quality assurance, and technology integration.

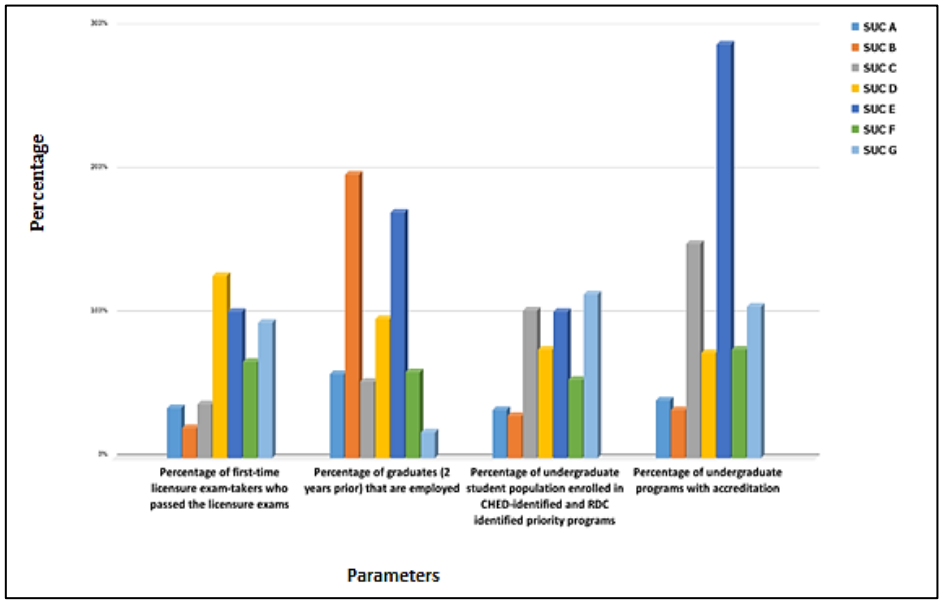

Figure 1: Performance of SUC's in Terms of Higher Education Service

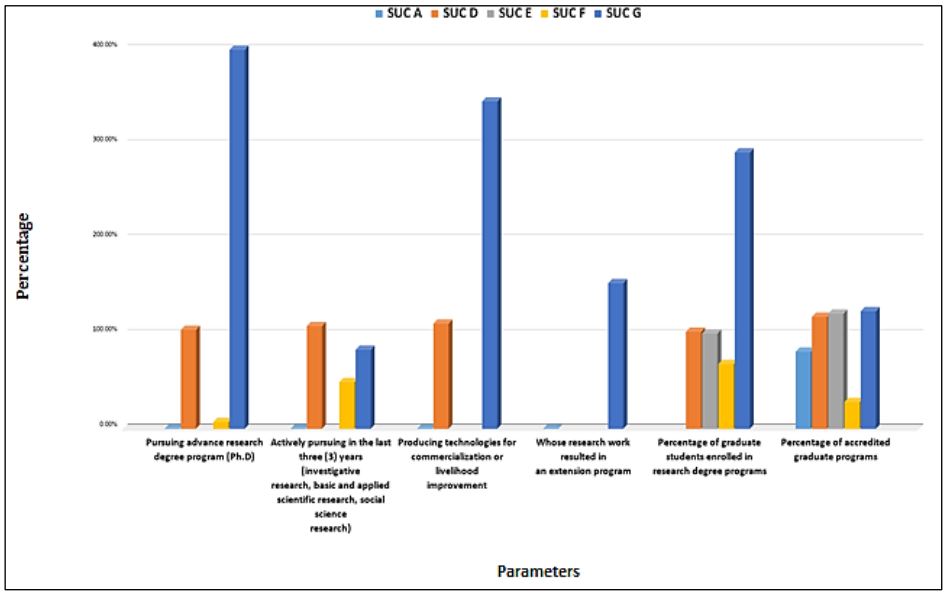

Figure 2: Performance of SUC's in Terms of Advance Education Services

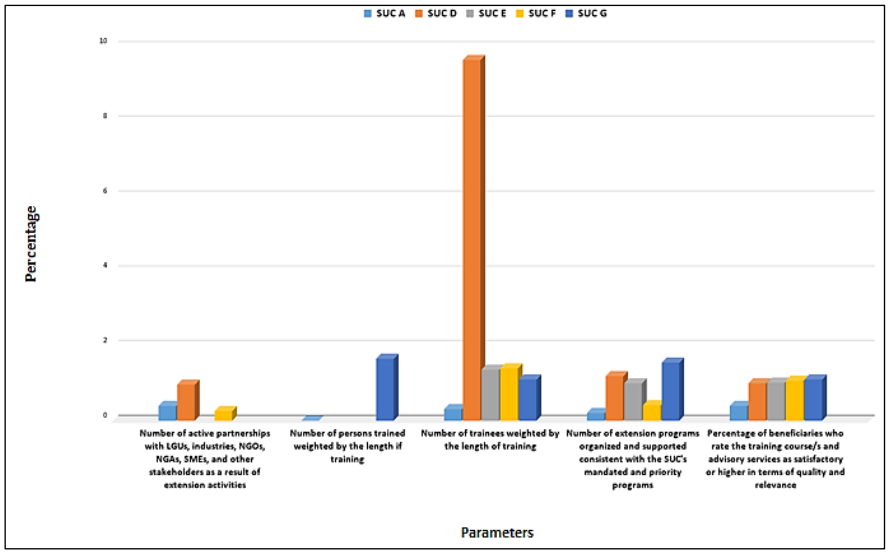

Figure 3: Performance of SUC's in Terms of Technical Advisory Extension Programs

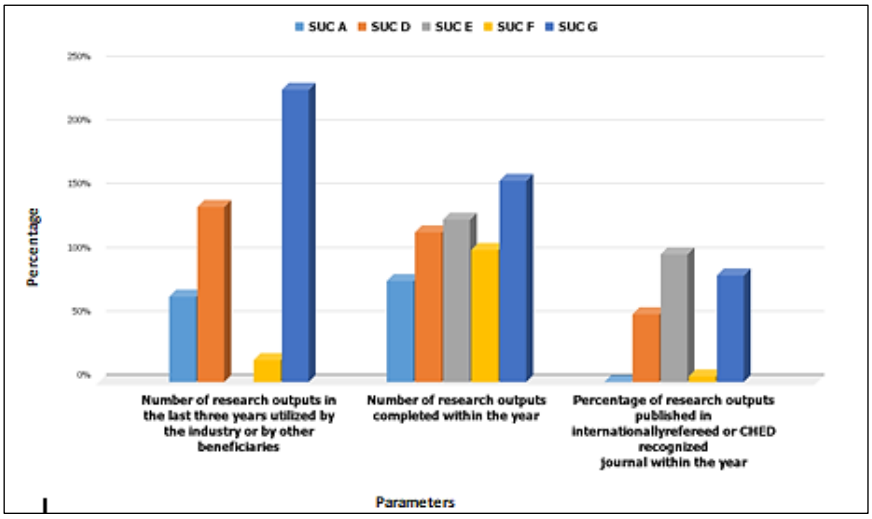

Figure 4: Performance of SUC's in terms of Research Programs

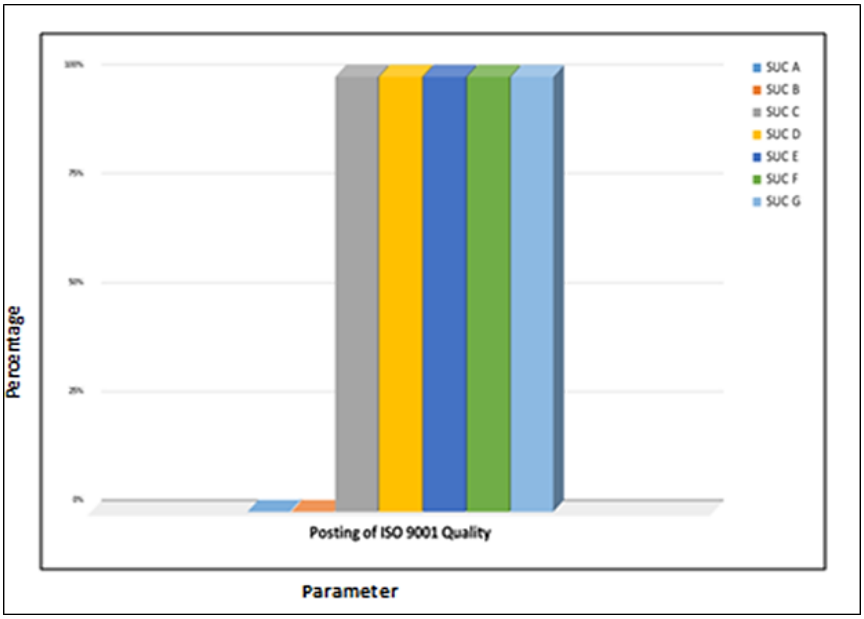

Figure 5: Performance of SUC's in terms of Support to Operations

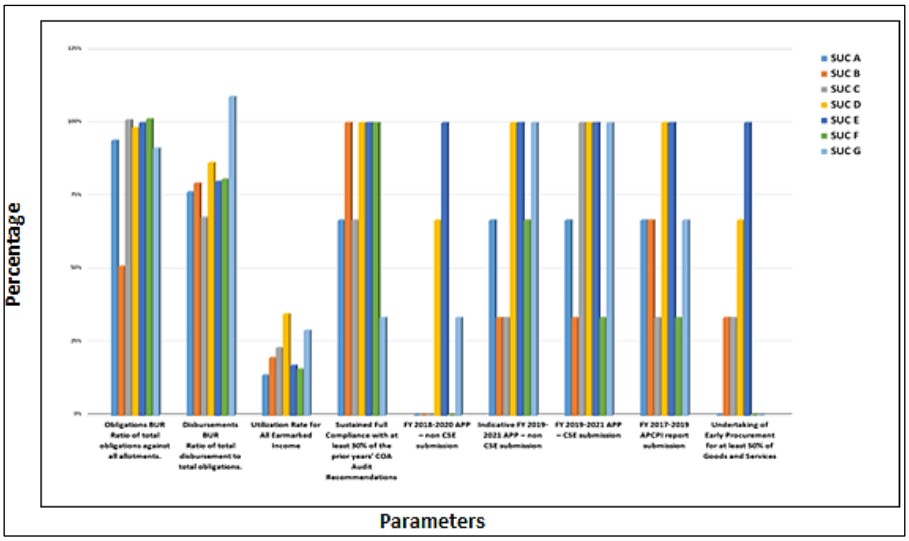

Figure 6: Performance of SUC's in Terms of General Administrative Support Service

Table 3: Composite Table on the Level of Technological Leadership State Universities and Colleges as Perceived by the Respondents

Technological Leadership	Mean	VI
Equity and Citizenship Advocate	4.34	Very Satisfactory
Visionary Planner	4.32	Very Satisfactory
Empowering Leader	4.39	Very Satisfactory
System Designer	4.23	Very Satisfactory
Connected Learner	4.42	Very Satisfactory
Grand Mean	4.34	Very Satisfactory

Table 3 shows that, as self-evaluated by educational leaders, their technological leadership in the various categories received a grand mean of 4.34, which is regarded as "Very Satisfactory." This clearly demonstrates that educational leaders exhibit high levels of technology leadership effectiveness across all aspects. Furthermore, the linked learner's technological leadership dimension had the greatest mean of 4.42, while the system designer dimension received the lowest mean of 4.23, both of which were orally characterized as "Very Satisfactory." The findings demonstrate that educational leaders consistently outperform in all categories of technical leadership, indicating that they prioritized each aspect of their position. This is demonstrated by their roles as connected learners, in which they model and promote professional learning for themselves and others, and as empowering leaders, in which they foster an environment in which teachers and students are encouraged to use technology creatively. It simply means that educational leaders are more focused as connected learners, participating in online professional networks, being reflective through technology, and developing skills needed to lead and advance systems to promote continuous improvement for how technology can improve learning. Pagaura examined the characteristics of school administrators at Bukidnon State University in the Philippines along four dimensions: visionary, team builder, relationship builder, and risk taker (25). Educators typically agreed with administrators' judgments of their own leadership innovation across all four aspects, according to the findings.

Table 4: Significant Relationship between the TQM practices of Educational Leaders and Performance of State Universities and Colleges

Performance Indicators	r	Sig	Ho	VI
Higher Education Services	0.177	0.192	FR	NS
Advance Education Programs	0.294	0.034	R	S

Research Programs	0.017	0.909	FR	NS
Technical Advisory and Extension Programs	0.035	0.812	FR	NS
Support to Operations	0.01	0.941	FR	NS
Overall	0.042	0.761	FR	NS

Table 4 depicts that there is a significant relationship between TQM practices and SUC's performance in terms of advanced education programs with a computed p-value of 0.034, which is less than 0.05 level of significance, and thus the null hypothesis is rejected. The results revealed that pursuing advanced education leads to success and promotion of the faculty, educational leaders and staff which has a great effect in the SUC leveling performance. The findings also show that the higher the output of advanced education programs, the greater the effort required practicing TQM for SUC's in NCR. This means that SUCs with a lower rate of faculty pursuing advanced research degree programs, conducting research, developing technologies for livelihood improvement and extension, and accredited graduate programs must work harder to release resources, particularly in support and It supports the findings of Motita II, who investigated SUCs in the National Capital Region (NCR) and discovered that TQM is well practiced in their respective institutions and has a significant impact on their school performance in terms of licensure examinations (26).

Table 5: Significant Relationship between Technological Pedagogical and Content Knowledge of Educational Leaders and Performance of State Universities and Colleges

Higher Education Services	0.057	0.676	FR	NS
Advance Education Programs	0.02	0.89	FR	NS
Research Programs	0.08	0.584	FR	NS
Technical Advisory and Extension Programs	0.128	0.38	FR	NS
Support to Operations	0.174	0.2	FR	NS
Overall	0.145	0.287	FR	NS

Table 5 depicts that there is no significant relationship between the technological, pedagogical and content knowledge and the university performance with the over-all computed p-value of .287, which is greater than 0.000 level of significance, and thus there is a need to fail to reject the null hypothesis. The result suggests that the performance of SUCs is unaffected by the TPACK capabilities of educational leaders. This implies that the use of TPACK for organizational management of educational has no appreciable impact on the institutional performance of SUCs and further supports the assertion that TPACK is better suited for use as a framework for the integration of technology in teaching than as a framework for institutional management of administrators and educational leaders. Several studies have used TPACK for classroom instruction like in Science Mathematics and English in elevating student performance which negates the findings as it shows limited relationship with respect to the university performance indicators (27-32). Further, this clearly shows that the TPACK framework is more suitable for technology integration for academic instruction and has no significant effect on the other performance indicators of the SUCs Similarly, the findings of this study bears significance on the findings of Depew who concluded that many principals lack important knowledge about technology and the ways technology can be employed to teach curriculum (33). Thus, TPACK framework is more suitable in curriculum instruction for educational leaders.

Table 6: Regression Analysis between the Total Quality Management Practices of Educational Leaders and the Level of Technological Leadership of State Universities and Colleges

Model	TQM practices	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	HO	VI
		B	Std. Error	Beta				
Technological Leadership	(Constant)	2.335	0.45		5.187	0	R	S
	Context of Organization	-0.95	0.467	-0.875	2.039	0.047	R	S
r2=.411	Leadership	-0.09	0.633	-0.083	0.139	0.89	FR	NS
F=.4792	Support	-0.49	0.506	-0.495	0.975	0.334	FR	NS
Sig. =.000	Operation	-0.6	0.424	-0.57	1.406	0.166	FR	NS
	Performance Evaluation	-1.17	0.472	-1.253	2.477	0.017	R	S
	Improvement	-0.57	0.442	-0.615	1.279	0.207	FR	NS
	Overall	0.579	0.128	0.525	4.538	0	R	S

It can be gleaned on Table 6 that in general, there is a significant relationship between the technological leadership and TQM practices of SUCs with the computed p-value of .000, which is less than 0.000 level of significance, thus, the null hypothesis is rejected. This therefore shows that technological leadership affects the TQM practices of educational leaders. Specifically, there is a significant relationship between the technological leadership and context of organization and performance evaluation with the computed p-value of .047 and .017 respectively which is less than 0.000 level of significance, thus, the null hypothesis is rejected. The result indicates that technological leadership depend in the context of organization and performance evaluation in ensuring quality management system outcomes. This means that the greater is the TQM practice of educational leaders in terms of organizational context and performance, the higher is the technological leadership of the SUC's in the NCR. This implies that, because the SUCs have identified the issues relevant to its context and purpose, established strategic directions to achieve the intended results of QMS, and established a method of reviewing and monitoring its performance leads to the very satisfactory technological leadership performance of educational leaders in the SUC's. Further, the data suggests that focusing on the needs of the clientele's faculty and staff by gauging their contextual practices and performance evaluation served as an input to effectively lead the technology integration in the system. This affirms the findings of Santos wherein similarly the context of organization got the highest mean where the emphasis is on determining the external and internal issues that are relevant to its purpose and determined the needs and expectation of interested parties that are relevant to the QMS which could be further enhanced through technological leadership of educational leaders (34).

Table 7: Regression Analysis between the Technological Pedagogical and Content Knowledge and the Level of Technological Leadership of State Universities and Colleges

Model	TPACK Capacities	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	H_0	VI
		B	Std. Error	Beta				
Technological Leadership	(Constant)	.497	.507		.979	.332	FR	NS
	Technology Knowledge	.093	.141	.089	.661	.512	FR	NS
	Content Knowledge	.031	.155	.026	.202	.841	FR	NS
	Pedagogical Knowledge	-.076	.162	-.079	-.470	.640	FR	NS

	Pedagogical Knowledge	Content	.335	.157	.385	2.129	.038	R	S
r^2=.648 F=12.645 Sig. =.000	Technological Knowledge	Content	-.077	.159	-.080	-.483	.632	FR	NS
	Technological Pedagogical Knowledge		.371	.194	.375	1.911	.062	FR	NS
	Technological, Pedagogical and Content Knowledge		.181	.182	.188	.997	.324	FR	NS
	Overall		.924	.100	.782	9.207	.000	R	S

It can be gleaned from Table 7 that in general, there is a significant relationship between the technological leadership and TPACK capacities of SUC's with the computed p-value of .000, which is less than 0.000 level of significance and thus, the null hypothesis is rejected. This therefore shows that the technological leadership affects the TPACK capacities of educational leaders. Further, there is a significant relationship between the technological leadership and pedagogical content knowledge with the computed p-value of .038 which is less than 0.000 level of significance, thus, the null hypothesis is rejected. The result indicates that the level of technological leadership of the educational leaders greatly affects their pedagogical content knowledge particularly if they can use the technology, they learned in demonstrating effective teaching approaches to guide learning in each content area taught in their respective school institutions. This implies that if a greater level of technological leadership is implemented in the institution, the higher the needed effort for the faculty to further enhance their pedagogical knowledge because the resources and training are already available, thus technology integration will be easy and will become a culture of practice. This affirms the study of Depew which shows a strong relationship between technology leadership and TPACK capacities of school principals, thus proving that technology integration for educational leaders' TPACK capacity development is indeed vital (35). Further, Morales *et al.,* found that the domains of pedagogy and content, assessment and reporting, and learner diversity and the learning environment were all represented in technology integration (TI) practices, demonstrating the unification of the technological pedagogical and content knowledge (TPACK) system (36).

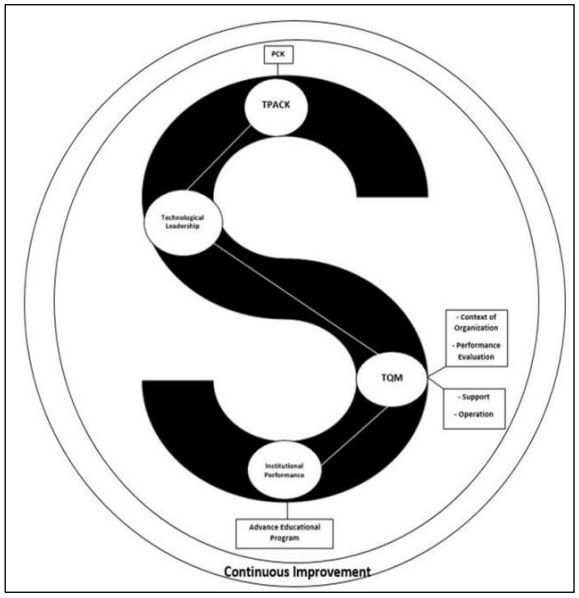

Figure 7: The Soriano Framework for Continuous Improvement of SUC's

Figure 7 shows the developed framework, developed through regression analysis, and highlights the importance of TPACK, particularly pedagogical content knowledge (PCK), for

technological leadership. It suggests that educational leaders can enhance their PCK and strategically select technology aligned with those competencies. Beyond individual leader development, the framework underscores the significant relationship between Total Quality Management (TQM) components, notably support and operation, and institutional performance, specifically advanced education programs. Organizational context and performance evaluation within TQM also influence technological leadership. Strong direct relationships are shown between TQM, technological leadership, TPACK, and institutional performance, ultimately contributing to continuous improvement, quality management, and enhanced SUC outcomes. The study implies that SUCs prioritizing their context and organization contribute to strong technological leadership. Furthermore, prioritizing technological leadership encourages faculty to enhance pedagogical knowledge, facilitated by available resources and training. Finally, achieving PBB targets requires faculty prioritization of the university's core functions: instruction, research, extension, and production services. The findings may be generalized to a wider academic framework for the NCR of the Philippines only.

Conclusion

Based on the hypotheses of the study, it is concluded that TQM practices influence the performance of State Universities and Colleges. Both TQM practices and TPACK components predict the technological leadership of State Universities and Colleges. The created framework suggests that educational leaders and administrators at SUC should focus on building their Pedagogical Content Knowledge (PCK) inside the TPACK model. This will help them make informed decisions about how to employ technology in the classroom that are in line with instructional goals. The quality of advanced education programs and technological leadership can be greatly enhanced at the institutional level by using Total Quality Management (TQM) principles, especially in organizational support, operational systems, and performance evaluation, thus achieving the PBB. Financial limitations, faculty reluctance, and infrastructure deficits are some of the obstacles to technology adoption that institutions must address through the implementation of focused policies and capacity-building programs for the use of educational leaders and other SUC's and HEI's stakeholders. To go even further into how these innovations could change leadership practices and institutional performance in SUCs, future studies can build on the identified predictors by investigating the integration of new technologies such as virtual learning platforms, blockchain, and artificial intelligence. Accordingly, the utilization of the proposed framework could lead to continuous improvement and input for the establishment of smart and future-ready colleges and universities.

Abbreviations

CHED: Commission on Higher Education, HEI: Higher Education Institution, NCR: National Capital Region, PBB: Performance Based Bonus, SUC's: State Universities and Colleges, TPACK: Technological Pedagogical Content Knowledge.

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Author Contributions

Joshua T Soriano: Conceptualization, Methodology, Data curation, Writing.

Conflict of Interest

The author reports that there are no competing interests to declare.

Ethics Approval

This study obtained its ethical approval and clearance with the following codes UREC-2022-0050 and REC code 05042022-065.

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