

Technology's application in the implementation of total quality management at hail university: Insights from department heads

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Abstract: This quantitative study examined the perspectives of departmental managers on the role of technology in the implementation of total quality management (TQM) at Hail University in Saudi Arabia. A sample of 60 departmental heads (36 men and 24 women) completed a two-part questionnaire. The questionnaire sought the demographic details of respondents, their thoughts on the utility of TQM in higher education in general, the role of technology in TQM implementation, the efficacy of TQM in achieving the Saudi Vision 2030, and the application of technology in the seven TQM principles as defined by the Baldrige-Education Criteria for Performance Excellence (NIST, 2004). According to the findings, technology is an extremely important component of the Total Quality Management (TQM) program at Hail University. Most of the department heads concluded that implementing TQM in the environment of the university is not only highly successful but also has the potential to help increase organizational performance. Furthermore, the study concluded that TQM implementation has become an important aspect of the field of education. This is because it significantly improves the university's administration and management efficiency. This study also discovered significant differences in how Hail University department heads used technology to implement TQM. Overall, females outperformed males, and younger people outperformed older people.

Keywords: Demographic, Department heads, Higher education, Principles, Technology, TQM,

1. Introduction

Today's universities symbolize the cultural and technological prowess of societies and countries, serving as key hubs for the world's intellectual, literary, scientific, and technological activities. Aloqlah [1] claimed that the growth of higher education institutions is interconnected and involves a systematic quality management framework as a tool and way of working to handle different parts of educational administration. So, a systematic quality management strategy must be used as both a tool and a way of working to keep an eye on the different parts of administrative work in higher education. Maintaining quality across an interconnected network of educational resources requires extensive research on the best ways to apply the principles of total quality, considering an accurate assessment of the current situation, an understanding of the problems, and a commitment to fixing them. Ibraheem [2] contended that the quality of education is measured based on three components: the quality of the human and material resources available for teaching (inputs), the quality of teaching practices (process), and the quality of the results (outcomes). Thus, improving the quality of education requires directing human resources, policies, systems, curricula, processes, and infrastructure in a way that encourages innovation and creativity. Following it can ensure achieving the goal of education, i.e., bringing students to their desired levels [3].

Total quality management (TQM) is an up-to-date approach to management, meant to improve efficiency and effectiveness in all a company's undertakings and affairs based on a set of carefully honed

principles that emphasize both administrative and creative approaches to problem-solving as well as technical expertise. TQM is not about turning schools, particularly universities, into for-profit enterprises whose only goal is to increase revenue by a factor of 10 [1]. Achieving high-quality education and maximizing the returns on educational investments for stakeholders such as the local community and educational institutions calls for the application of TQM to the development of educational administrative procedures [4].

Unfortunately, quality management in Saudi universities has been found to be rather ineffective. Universities in the Arab world, including Saudi Arabia, have been dealing with a lack of autonomy and “multiple levels of administrative and hierarchical episodes in writing reports and settings” [5]. According to Kamal Al-Din and Abouzid [6], assessing educational institutions is the most important part of TQM in higher education. This is especially true when it comes to building up and improving institutions. Implementing the principles of TQM helps each university develop a vision and a mission and boosts the morale of staff, improving the quality of their workplace. Kamal Al-Din and Abouzid [6] maintained that a university’s departments could be seen as the first unit of the overall organization. The goals of the university are achieved through these departments. Therefore, it is crucial to put the right policies in place to improve the overall skills of department heads in the field of management. How well they handle their tasks depends mostly on their skills and experience in aspects such as teaching. However, these skills may not be relevant to dealing with administrative matters, especially with teachers assigned as department heads. Currently, higher education institutions are aiming to implement TQM as it also helps them gain a competitive advantage. In this regard, Ibraheem [2] argued that higher education institutions should adopt TQM to improve their performance, raise their level of productivity, and improve the quality of their graduates; in return, graduates of such institutions will be scientifically, practically, and technically qualified to serve society, help it reach its goals, and maintain a high level of progress and development.

The function of technology in the implementation of quality management in universities is growing in importance. Higher education institutions are no longer restricted to the student markets or educational resources of their geographic regions due to advanced communication technologies. Similarly, the increasing demand for lifelong learning opportunities to keep up with social, economic, and technological change is driving the demand for accessible alternatives to traditional on-campus real-time instruction [7]. According to Burgin [8], technology in education consists of three main elements: (1) the organization and management of the educational system, (2) the satisfaction of certain additional needs of educational systems and educators (such as the provision of information, means of communication, word processing, etc.), and (3) the realization of a 'teaching/learning' process. This final category is known as educational technology, and it contains three components. The first and most evident is the use of technology in teaching and learning. The second part is educational technology, and the third is instructional technology. The latter two sorts of technologies are known as instructional technologies or pedagogical technologies. These devices are typically associated with the modern idea of technology in the classroom.

However, the focus of today's classrooms is mostly on computer and electronic device use, rather than technology as a whole. There is a tremendous increase in the use of computers and instructional software. Computer literacy, classroom management, and student involvement in learning are three primary areas of use. The first is the study of technology itself. Second, in the realm of educational technology, there are issues with classroom management that need to be addressed. Technologies for instruction and assessment comprise the third category [9].

One subset of educational technologies is computer-based ones, which make use of computers themselves as instructional instruments. It is more productive, then, to view computers as an essential part of a larger technological system. Despite the vast potential presented by modern computers, the current usage of computers in education is ineffective. Because there aren't any universally applicable computer-based technologies, this is the case. Only guidelines and procedures for using computers to learn are being created. However, due to the wide variety of adverse effects, these approaches are

insufficient [10]. Methods and guidelines often fail to account for these consequences, but technological advancements do. This is why it is critical to adopt a technological strategy for education and training.

Despite the promise of technology, its integration into higher education has not been quick or painless. Many barriers to technological innovation exist within higher education institutions. Academic traditions, such as teacher-centered lectures, mean that many professors are reluctant to adopt alternative teaching strategies using computers or telecommunication devices. The cost of many technological applications also prevents their easy adoption in many resource-constrained institutions. Before technology became central to institutional operations, many institutions paid for new or upgraded technologies with funds left over at the end of their annual budget cycle. Now that technology has become an essential, recurring investment, most institutions must find additional funds to meet their growing needs for technological resources [11]. Limited support for faculty and staff to learn how to take full advantage of technology is another factor hindering the more widespread use of technology in higher education institutions. According to Timotheou [12], the most important technological challenge facing higher education institutions is to help teachers integrate information technology into their teaching. The second most important challenge is to provide adequate support for users. Higher education's investment in technological hardware is not, in itself, sufficient to reap the full benefits of new technological advances. This author concludes that "the real challenge [of information technology] is people, not products" (p. 1). Technology will not realize its full potential and revolutionize higher education if the obstacles to its adoption are not satisfactorily resolved by individual institutions or the education system as a whole [11]. So, to implement quality management, college faculty must improve their technological skills through professional development and training. This benefits not only them but also their students. Integrating technology into higher education can change the way people learn and teach by improving the learning experience for students and giving them a more well-rounded degree, which is important in today's knowledge economy [13]. However, for technology to be used effectively in teaching and learning, the right goals, expectations, and criteria must be established [14]. Staff should also stay aware of emerging technology and adopt positive attitudes toward it. Hence, it is important that all stakeholders take part in the integration process [15].

1.1. Problem Statement

Quality management has far-reaching effects on higher education, especially on students, who are more likely to be physically and mentally healthy, more open to collaboration with others, and more determined to achieve their goals with the help of their community. The environment also improves, becoming hazard-free while preserving sufficient resources and capacity; course materials are presented in a meaningful curriculum; student-centered training and assessment methods are implemented; and educational disparities are reduced [16].

The continuous and rapid development of the economy and education in Saudi Arabia has forced universities to adopt total quality management (TQM) to achieve continuous improvement. The dynamics of technology and globalization can also be seen as a motivation for the implementation of TQM as a government policy affecting procedures, management, and leadership in Saudi universities [17]. The implementation of technologies inside and outside of the traditional classroom seeks to transform the overall environment of institutions of higher education. By facilitating and mediating the learning process, technologies (also known as "ed-tech") can considerably improve the quality of instruction and, consequently, the learning experience of students [18]. Moreover, in a rapidly transforming technological landscape where innovation drives industry transformation, it is essential to remain abreast of the most recent education technology trends to guarantee the delivery of quality education.

By gaining a thorough comprehension of these trends, educators and administrators will be able to make data-driven decisions regarding how to integrate the appropriate technology, raise education standards, and equip students with the necessary skills for success in the workforce of the future. Staying abreast of the most recent ed-tech trends can provide a strategic advantage for students,

educators, and administrators, allowing them to distinguish themselves in a competitive marketplace and achieve exceptional educational outcomes.

Unfortunately, teaching in Saudi Arabia remains outdated and teacher-centric, emphasizing students' development of lower-level thinking skills. Additionally, technology integration in higher education remains a complex process made more difficult by the fact that many higher-education institutions adopt technology integration without adequate institutional policies and strategies defined by enabling frameworks to develop and implement the integration [15]. According to Kamal Al-Din and Abouzid [6], a university's departments are the first unit of the overall organizational structure. These departments help universities achieve their objectives and goals. Therefore, it is essential to implement the necessary policies to improve the overall management capability of departments. In light of this, a study addressing department heads' perceptions and use of technology to apply TQM concepts into their departments' management appears both topical and important.

1.2. Research Framework and Hypothesis

A research framework facilitates the provision of an underlying structure to support collaborative research efforts. A research framework can "occasionally be regarded as more of a jumbled collection of activities." However, research is a domain of great variety, has a variable scope, and can be used to address a wide range of questions regarding business, product, and delivery. In this context, this study was conducted to see if there was a relationship between the type of technology utilized and the degree to which TQM principles were being put into practice across different departments at Hail University. This research also looked at how demographic variables including age, gender, and years in the workforce impacted how people at Hail University used technology to further TQM initiatives. In addition, information about the technology employed at Hail University to apply TQM principles was collected for the study. A survey was used for this aim, as this is a popular strategy for studying educational issues [19]. It is well-established that survey-based research is reliable and valid. Furthermore, the study used quantitative techniques extensively. Utilizing the survey, the study collected information regarding Hail University's utilization of technology for TQM implementation. The questionnaire was originally designed by Couch [20] to evaluate the perceived levels of TQM implementation in a sample of North Carolina community colleges. The questionnaire was adapted by the researcher to align with the requirements of this study. Its validity and reliability were assessed by administering it to a sample of 30 faculty members. The TQM Cronbach's alpha coefficient was found to be 0.862, while the Principles' Cronbach's alpha ranged from 0.561 to 0.854. The formulated hypotheses were then tested, drawing upon existing literature reviews, and recognizing the significance of technology in the implementation of quality management in higher education.

H₁: Technology is used to support quality management at Hail University in Saudi Arabia.

H₂: In particular, technology was employed to implement the teaching and learning process, and to a lesser extent, to organize and govern the educational system.

H₃: The usage of technology in the implementation of TQM at the University of Hail varies according to the gender, age, and years of experience of department heads.

The seven principles of quality management that were analyzed in the previous literature were used to test these hypotheses.

1.3. Purpose of the Research

This research aims to determine the extent to which technology has been used to support TQM at Hail University and thus determine the role of technology in TQM implementation. The study focuses primarily on how technology aids and supports TQM processes rather than on the performance of TQM. The primary research question is as follows: How useful is technology considered by department heads at Hail University in applying TQM? To address this question, the following research objectives were set: (i) to investigate the relationship between the use of technology and the degree to which TQM principles are put into practice in the various departments at Hail University, (ii) to identify the types of

technology used at Hail University in implementing TQM principles, and (iii) to assess the impact of personal variables (age, gender, and years of experience) on the use of technology to implement TQM principles at Hail University

2. Literature Review

According to Zabadi [21], the Arab world has recently been experiencing drastic changes in various fields of life. Thus, corporate, and private institutions need to adapt their management and administration styles accordingly by modernizing them to achieve the set objectives. This can confer a competitive advantage to organizations. The integration of TQM in universities can assist these institutions in providing excellent service quality. TQM can also help universities meet the needs of faculty members and other employees, students, and society. Most of the challenges encountered when integrating technology into higher education are the result of many institutions failing to adequately promote the adoption of new technologies at the policy level and/or through campaigns to implement technologies in their practices [15]. Alghamdi, Mostafa, & Abubshait [22] found that pedagogical attitudes and beliefs are the most important factors in the successful use and integration of technology in higher education. Therefore, it is important for the staff to be familiar with and excited about new technologies to effectively achieve technology integration; furthermore, the participation of stakeholders in the integration process should be facilitated. During the integration process, the administrative support departments of some colleges are not always available to help teachers and students, and this serves as a disruptive and discouraging factor. Sife, Lwoga, & Sanga [15] posited that it is hard to give good technical assistance to developing countries because they do not have enough qualified people. Another thing that makes it hard for tertiary institutions to successfully integrate technology is that faculty and students face trouble in adapting to their changing roles. Integration of information and communication technologies into universities requires not only new hardware and software but also new responsibilities and ways of acting on the part of both students and faculty. As the cost of technology keeps going up, universities are also struggling with raising funds for this purpose. Significant monetary investments are needed for schools to integrate information and communication technologies [15].

Overall, the use of technology in higher education has benefited the teaching and learning process and the students themselves. Using modern technologies in higher education has led to improvements in active learning, better academic performance, increased collaboration between students, better feedback channels, and improved information retention [23]. In a learning environment where technology is used, students can interact with the learning material meaningfully, pay more attention and are more involved in the learning process, work easily with other students outside of the classroom, remember facts about topics better after the class is over, and can better assess what they have learned without the lecturer's help [24]. Turugare and Rudhumbu [23] explained that the benefits of integrating technology into the teaching and learning process depend mostly on the teachers' perception and use of these technologies and how easy the technologies are to use. Moreover, Shiboko [25] found that younger teachers were more likely to use technology in the classroom than older teachers who were afraid of new technologies and found them scary. Blackwell, Lauricella, & Wartella also [26] ascertained that teachers with more experience harbor fewer positive feelings toward technology use. Shiboko [25] also noted that, compared to men, women tend to possess lower levels of skills and interest in computers as well as their use, irrespective of their education level because they do not have as much access to technology.

2.1. Key Concepts and Principles of TQM

According to Manatos, Sarrico, & Rosa [27], whole quality is a customer-centric management philosophy that employs statistical tools, employee teams, and performance management to continuously improve product and service quality. This management approach is referred to as "total" by Cartin [28] because it involves every member of the organization and every function and activity.

Total engagement recognizes that every action affects quality and productivity and that those involved in the activities (processes) are best adapted to identify opportunities for improvement. Quality is the dimension by which the value of the method is measured. It focuses on improving the quality of all functions, systems, and processes, including the elimination of poor output and the enhancement of quality output. Management in this context is not administrative personnel directing or controlling the work of a group of employees; rather, it is the actions involved in applying the principles and techniques of TQM to all activities.

TQM has multiple essential components. They include processes and systems, a focus on the customer, continuous improvement, fact-based management, and respect for individuals. Processes and systems are defined as “a series of procedures designed to accomplish a specific objective” and “an organization of people, places, things, and/or events that produces, enables, or makes possible the occurrence of certain occurrences,” respectively. In this regard, Couch [20] argued that management controls at least 85% of the system, while laborers control 15%.

The second crucial aspect of quality management is that a company's customer service must match the quality of the products or services it offers. Marchese [29] argued that a customer focus requires businesses to identify their exact clientele.

In terms of continuous improvement, the constant pursuit of improvement is both an end in itself and a means to that end. The PDCA (Plan, Do, Check, Act) cycle constitutes a good strategy for this continuous development. This cycle occurs at every level of management. In the “Plan” phase, the following questions are posed: What changes need to be made? What results are expected? What problems need to be solved? Which data are already available? Which new data are needed? The “Do” phase involves implementing a tweak or conducting a pilot test to gather data for the deliberations in the “Think” phase. In the “Check” phase, the results of the experiment or implementation of the change are evaluated. Finally, in the “Act” phase, a decision for further action is made based on the findings of the previous steps.

The management of any program necessitates data collection and decision-making in light of the available evidence as opposed to the manager's feelings or assumptions. Information can be gathered in a variety of ways and then used for decision-making. Fishbone diagrams (also known as cause-and-effect diagrams), control charts (sometimes called flowcharts), Pareto charts, flowcharts, brainstorming, nominal group technique, and affinity diagrams are the seven main tools used in quality movement as a whole.

Finally, Deming [30] based eight of his 14 hypotheses on the principle of individual respect. As a result, the individual will be held accountable for their actions and dedicated to the overall success of the program, team, and business. Assisting others to realize their full potential as workers through training and coaching, facilitating efficient communication to increase productivity in the workplace, and recognizing and rewarding people for going above and beyond the call of duty are all simple ways to show respect for others. When workers are provided with some autonomy, they will stop merely following commands and start looking for methods to improve output quality on their own accord.

2.2. TQM in Higher Education

In higher education, quality management prioritizes student learning. However, as noted by Manatos, Sarrico, & Rosa [27], several sources have suggested that there are significant differences between the business world and higher education; thus, careful consideration is necessary for the adaptation of business concepts to academic settings. For example, Couch [20] noted that some keywords or phrases associated with TQM do not always work well in higher education; for example, “management” cannot be used in academic titles, students cannot be referred to as “customers,” and so on. Administration and teaching are complicated by the structure's dual nature. The fragmentation of the university into specialized departments has resulted in increased disciplinary and/or departmental loyalty among faculty members at the expense of institutional allegiance. Higher education has its own unique culture. In higher education, conservatism is ingrained, and the prevalence of different attitudes,

practices, and rules can hinder the teamwork required for effective comprehensive quality management. Finally, human capital investment in higher education is far more difficult than corporate profitability, and people are naturally hesitant to modify what has worked effectively in the past. There has been a major reduction in the power of the administration in higher education to carry out institutional reforms. In administrative positions, the ability to influence others and take charge is crucial. Teachers can impact this type of change. It is widely agreed that academic freedom is a defining feature of universities [20].

2.3. TQM Implementation in Higher Education in Saudi Arabia

In the Saudi higher-education context, the quality trend began in the early 2000s when certain Saudi universities, such as King Saud University (KSU), King Abdulaziz University (KAU), and King Fahd University of Petroleum and Minerals (KFUPM), implemented quality procedures but only to a limited extent. This has resulted in a low level of service quality. Teamwork, service improvement efforts, and a focus on the end user were found to be the practices most in line with the quality idea [31]. The employees of the KSU Information Center, one of the largest university information centers in Saudi Arabia, indicated that TQM was implemented at the intermediate level and that employees understood certain quality principles, including teamwork, at the granular level [32]. Alhemali [32] argued that to boost service quality, top-level managers should foster a quality culture and adopt quality principles.

Furthermore, Alzhrani, Bashayer Ali Alotibie, & Abdulaziz [16] claimed that several universities in Saudi Arabia have successfully adopted TQM. For instance, KAU adopted TQM as one of the fundamental aspects of its strategic plan and applied TQM to initiate further developmental measures. Moreover, KAU established a TQM department that plans, develops, and participates in processes related to executing quality programs and monitoring quality. This includes measuring performance and assessing it, thereby focusing on the continuous development of the process. Alzhrani, Bashayer Ali Alotibie, & Abdulaziz [16] pointed out the “many achievements of the TQM department resulting from the effective implementation of the TQM concept.” These achievements include “the academic accreditation gained for some colleges at the university”. The university administration is highly committed to implementing a quality-oriented principle concerning client focus, employee involvement, system management, leadership, and more. Thus, KAU is one of the pioneering universities emphasizing the development of a complete quality program.

On another note, Aldaweesh, Al-Karaghoul, & Gallear [33] explained that globalization has significantly contributed to the impetus for universities to ensure quality and implement quality-assurance models. This is mainly done to help universities survive in the competitive global market. Thus, Saudi Arabia’s institutions of higher education need to invest in enhancing the quality of universities to meet the government’s strategy. TQM is still considered to be an emerging idea in the field of education. The top management of Saudi universities should focus on implementing the principles of TQM to enhance institutional performance. In this regard, Alzeaideen [34] argued, “It is essential for universities to learn from the practices and to focus on their main processes, especially teaching or learning procedures, and there must be a systematic appraisal of the performance, which is to be done by TQM.”

3. Materials and Methods

3.1. Population and Sampling

All 99 department chairs and vice deans at Hail University were included in this study, which included 26 females and 73 males [35]. Due to its small size, this entire population was selected for the study. Further, only 60 of the 99 surveys returned (36 males and 24 females) were found to be complete. With a 5% margin of error and 95% confidence level, a response rate of 60.6% was regarded to be satisfactory in this type of study. All the responses and data were considered while selecting the sample group. From this, the participant’s feelings about the implementation of TQM on campus were inferred.

3.2. Data Collection

Data were collected using a predetermined questionnaire. Cronbach's alpha was employed to check the questionnaire's internal consistency and reliability, and it was made sure that the necessary data could be obtained. The statistical significance level of the test results was $\alpha = 0.867$, indicating that the questionnaire was sufficiently dependable for use in the research. Expert opinion was also used to ensure that the instrument's content was valid. The experts' feedback was considered while finalizing the instrument. A total of 99 online surveys were administered to department heads, out of which 60 responded.

3.3. Questionnaire

The survey questionnaire posed many questions about how much technology was used to implement TQM principles in higher education. The questionnaire consisted of two parts. The first section of the survey gathered data pertaining to the participants' department, college affiliation, gender, age, and professional background. Additionally, it sought to gather their views on (1) the suitability of Total Quality Management (TQM) in the context of higher education, as indicated by the question, "To what extent do you believe that total quality contributes to the enhancement of management functions?"; (2) the importance of technology in the implementation of TQM, as indicated by the question, "To what extent do you believe that technology facilitates the implementation of TQM?"; (3) the specific technological tools utilized in the implementation of TQM within the department, as indicated by the question, "What technology do you use in the implementation of TQM in your department?"; and (4) the effectiveness of TQM in accomplishing the objectives outlined in the Saudi Vision 2030, as indicated by the question, "To what extent do you believe that TQM is highly effective in achieving the goals set forth in the Saudi Vision 2030?".

The participants provided responses of either "Yes" (coded as 1) or "No" (coded as 0) for questions 1, 2, and 4. In contrast, question 3 was an open-ended inquiry, prompting participants to list all technological tools utilized in the implementation of Total Quality Management (TQM) concepts. The responses were systematically analyzed and categorized into three distinct groups: (1) The organization and management of the educational system, (2) The satisfaction of certain additional needs of educational systems and educators, and (3) The realization of the 'teaching/learning' process. The overall utilization of technology in the implementation of Total Quality Management (TQM) principles was assessed based on the total count of technological tools mentioned. On the other hand, the second section comprised 21 questions about the use of technology in relation to the seven principles of TQM categorized by the National Institute of Standards and Technology [36].

The TQM principles were as follows: "leadership" in items 1–3, "information and analysis" in items 4–6, "strategic and operational planning" in items 7–8, "human resource development and management" in items 9–12, "education and business process management" in items 13–15, "community college performance results" in items 16–18, and "student focus and student stakeholder satisfaction" in items 19–21. A six-point Likert-type scale was used for the 21 questions and (0: no knowledge of statement, 1: strongly disagree with the statement, 2: disagree, 3: neither agree nor disagree, 4: agree, 5: strongly agree). Regarding the use of technology in the TQM implementation, the statements were worded positively. In order to assess the extent to which technology is utilized in the application of quality management principles in a broad sense, a mean score was computed based on the responses supplied by participants to the 21 questions outlined in the survey instrument's second section. The calculation of a distinct score for each principle involved aggregating the responses to the corresponding questions and subsequently dividing the sum by the total number of questions. The scores obtained were differentiated into five levels by adding five times the product of the interval divided by 6 to zero: The scoring system ranges from 0 to 0.83, indicating a complete absence of technology usage. Scores between 0.84 and 1.66 suggest a very limited utilization of technology. Scores falling within the range of 1.67 to 2.51 indicate a low level of technology use. Medium technology use is represented by scores ranging from 2.52 to 3.36.

High technology use is indicated by scores between 3.37 and 4.21. Finally, scores of 4.22 or higher signify a very high level of technology use.

3.4. Data Analysis

Means, standard deviations, frequencies, and percentages are used to express the results. The Shapiro-Welk test was used to examine the normality of distributions, revealing non-normal distributions among all variables. The frequencies were subjected to comparison through the utilization of Chi-square tests. The Mann-Whitney U test was used to evaluate whether there were statistically significant differences between male and female participants in terms of the number of technological tools used and their utilization in implementing TQM principles. Furthermore, the Kruskal-Wallis test was utilized to compare the aforementioned factors, taking into account the age and years of experience of the individuals. The relationship between the deployment of technology and the application of TQM principles was assessed through the implementation of the Pearson correlation test. Cohen's d values were calculated and used as an effect size (ES) index, with thresholds of 0.20, 0.60, 1.20, 2.0, and 4.0 adopted for trivial, small, moderate, large, and very large effects, respectively [37]. For analysis, the Statistical Package for the Social Sciences version 26 (IBM Corporation, Armonk, NY, USA) was employed, and differences were deemed significant at $p \leq 0.05$ (two-sided).

Table 1.

Participants' gender, age, and experience and their overall perspective on the utility of total quality in improving management functions, technology use, and TQM efficiency in achieving the Saudi Vision 2030.

		Number	%	Yes	%	No	%	
Gender	Male	36	60					
	Female	24	40					
Age	30–35 years	7	11.66					
	36–40 years	20	33.33					
	41 years old and above	33	55					
Experience	≤5 years	10	16.66					
	6–10 years	20	33.33					
	11 years or above	30	50					
Do you think total quality helps in improving management functions?	Total			54	90	6	10	
	Male			31	51.66	5	8.33	$X^2 = 1.512$
	Female			23	38.33	1	1.66	$p = 0.219$
	30–35 years			7	11.66	0	00	$X^2 = 4.44$
	36–40 years			20	33.33	0	00	$p = 0.108$
	41 years old and above			27	45	6	10	
	≤5 years			11	18.33	0	00	$X^2 = 7.126$
	6–10 years			18	30	2	3.33	$p = 0.028$
11 years or above			25	41.66	4	6.66	$d_{\text{Cohen}} = 0.734$	
Do you think technology helps in the implementation of TQM?	Total			56	93.33	4	6.66	
	Male			33	55	3	5	$X^2 = 0.402$
	Female			23	38.33	1	1.66	$p = 0.526$
	30–35 years			7	11.66	0	00	
	36–40 years			19	31.66	1	1.66	$X^2 = 2.857$
	41 years old and above			30	50	3	5	$p = 0.24$
	≤5 years			11	18.33	0	00	$X^2 = 4.581$

	6–10 years		20	33.33	0	00	p = 0.101
	11 years or above		25	41.66	4	6.66	
Is TQM highly efficient in attaining the Saudi Vision 2030?	Total		50	83.33	10	16.66	$X^2 = 0.5$ p = 0.48
	Male		29	48.33	7	11.66	
	Female		21	35	3	5	
	30–35 years		7	11.66	0	00	$X^2 = 8.00$ p = 0.018 $d_{\text{Cohen}} = 0.785$
	36–40 years		18	30	2	3.33	
	41 years old and above		25	41.66	8	13.33	
	≤5 years		11	18.33	0	00	$X^2 = 12.828$ p = 0.002 $d_{\text{Cohen}} = 1.043$
	6–10 years		16	26.66	4	6.66	
	11 years or above		23	38.33	6	10	

4. Results

The gender, age, and experience of participants are displayed in Table 1. In response to the query asking for their opinions regarding whether total quality helps in improving management functions, only one-tenth of the participants responded negatively (six participants: five men and one woman). They all were at least 41 years old, with work experience of 6–10 years (two participants) or 11 years or more (four participants). The observed disparities in relation to the encountered situation exhibited statistical significance at a significance level of $p = 0.028$, accompanied by a modest effect size ($d_{\text{Cohen}} = 0.734$). In response to the question regarding the role of technology in the implementation of TQM, most participants (56 out of 60) agreed that technology is beneficial, while only four (three men and one woman) disagreed. The latter were all at least 41 years old and had a minimum of 11 years' experience.

Further, a total of 10 participants (seven men and three women) concurred that TQM is ineffective for achieving Saudi Vision 2030. Two were between the ages of 36 and 40, while eight were 41 or older, with experience of 6–10 years (four participants) and 11 years or above (six participants). The results of the Chi-Square test indicated that there were statistically significant differences observed between groups based on age ($X^2 = 8.00$; $p = 0.018$; $d_{\text{Cohen}} = 0.785$) and experience ($X^2 = 12.828$; $p = 0.002$; $d_{\text{Cohen}} = 1.043$).

Data pertaining to the incorporation of technology tools in the application of TQM principles revealed that both male and female department heads exhibited comparable levels of technology utilization, except for meeting supplementary educational system prerequisites. In the present study, it was shown that female department heads demonstrated a greater utilization of technological tools as compared to their male counterparts (mean \pm standard deviation: 0.96 ± 0.55 vs. 0.47 ± 0.70 ; $p = 0.001$; effect size (Cohen's d) = 0.766). Nevertheless, significant discrepancies were identified when classifying cohorts according to age and level of expertise. The findings indicate that department heads who were 40 years old or younger or who had less than 10 years of experience demonstrated a statistically significant increase in the application of technology while implementing TQM principles. The effect sizes observed were of moderate magnitude, as shown in Tables 3 and 4.

Table 2.

Use of technology in implementing TQM principles and the number of tools used, by gender of department heads.

	Total (N=60)	Male (N=36)	Female (N=24)	Z	p	d_{Cohen}
TQM principles						
Leadership	2.63±0.95	2.39±0.90	3.00±0.91	-3.75	0.001	1.154
Information and analysis	2.26±0.35	2.22±0.33	2.31±0.38	-1.19	NS	
Strategic and operational planning	2.30±0.41	2.28±0.47	2.33±0.32	-0.10	NS	
Human resource development and management	3.40±0.40	3.30±0.39	3.55±0.38	-2.07	0.038	0.539
Education and business process management	3.27±0.52	3.13±0.52	3.49±0.44	-2.54	0.011	0.677
Community college performance results	4.27±0.36	4.19±0.32	4.38±0.40	-2.12	0.034	0.539
Student focus and student and stakeholder satisfaction	2.34±0.55	2.36±0.59	2.32±0.50	-0.47	NS	
TQM	3.93±0.34	3.83±0.31	4.08±0.34	-3.94	0.001	1.002
Number of technological tools used						
Organization and management of the educational system	1.93±0.97	1.83±0.78	2.08±1.21	-1.36	NS	
Satisfaction of certain additional needs of educational systems and educators	0.67±0.68	0.47±0.70	0.96±0.55	-3.05	0.001	0.766
Realization of the 'teaching/Learning' process.	2.72±0.72	2.61±0.69	2.88±0.74	-1.40	NS	
Use of technology in general	5.32±2.12	4.92±1.95	5.92±2.26	-1.79	NS	

Note: Results are presented as mean ± SD. NS, not significant.**Table 3.**

Use of technology in implementing TQM principles and the number of tools used, by age of department heads.

	30–35 (N=7)	36–40 (N=17)	41 years old and above (N=36)	KW	p	d_{Cohen}
TQM principles						
Leadership	3.19±0.26	3.14±0.35	2.29±1.06	14.76	0.001	1.086
Information and analysis	2.33±0.19	2.45±0.20	2.15±0.39	10.58	0.005	0.842
Strategic and operational planning	2.50±0.00	2.41±0.20	2.21±0.50	4.53	NS	
Human resource development and management	3.46±0.49	3.57±0.35	3.31±0.38	3.98	NS	
Education and business process management	3.52±0.47	3.41±0.40	3.16±0.55	4.26	NS	
Community college performance results	4.38±0.36	4.41±0.30	4.17±0.37	6.63	0.036	0.595
Student focus and student and stakeholder satisfaction	2.48±0.38	2.49±0.36	2.25±0.63	1.41	NS	
TQM	4.23±0.23	4.09±0.18	3.80±0.35	18.76	0.001	1.189
Number of technological tools used						

Organization and management of the educational system	2.57±0.79	2.35±0.79	1.61±0.96	10.17	0.01	0.818
Satisfaction of certain additional needs of educational systems and educators	1.00±0.58	1.06±0.43	0.42±0.69	15.48	0.001	1.113
Realization of the 'teaching/Learning' process.	3.00±0.58	3.06±0.56	2.50±0.74	10.35	0.01	0.829
Use of technology in general	6.57±1.51	6.47±1.37	4.53±2.17	13.53	0.001	1.007

Note: Results are presented as mean ± SD. NS, not significant.

Table 4.

Use of technology in implementing TQM principles and the number of tools used, by years of experience of department heads.

	< 5 years (N=11)	5 years to <10 years (n=20)	10 years or above (n=39)	KW	p	<i>d</i> _{Cohen}
TQM principles						
Leadership	3.00±0.42	3.10±0.38	2.17±1.14	14.01	0.001	0.982
Information and analysis	2.39±0.20	2.38±0.25	2.11±0.40	10.19	0.006	0.819
Strategic and operational planning	2.45±0.15	2.40±0.21	2.17±0.54	3.97	NS	
Human resource development and management	3.48±0.48	3.54±0.28	3.28±0.41	4.45	NS	
Education and business process management	3.58±0.40	3.32±0.46	3.13±0.55	5.68	NS	
Community college performance results	4.42±0.34	4.37±0.30	4.14±0.37	6.66	0.036	0.597
Student focus and student and stakeholder satisfaction	2.45±0.34	2.45±0.44	2.23±0.66	1.71	NS	
TQM	4.20±0.23	4.04±0.21	3.76±0.36	14.09	0.001	1.083
Number of technological tools used						
Organization and management of the educational system	2.27±0.91	2.25±0.91	1.59±0.95	7.32	0.026	0.642
Satisfaction of certain additional needs of educational systems and educators	1.00±0.63	0.80±0.52	0.45±0.74	8.47	0.020	0.715
Realization of the 'teaching/Learning' process.	3.00±0.63	2.95±0.69	2.45±0.69	9.13	0.010	0.756
Use of technology in general	6.27±1.74	6.00±1.84	4.48±2.16	9.84	0.010	0.799

Note: Results are presented as mean ± SD. NS, not significant.

Tables 2, 3, and 4 present the participants' scores pertaining to the utilization of technology in the execution of TQM principles. The overall TQM score at Hail University was found to be 3.93 ± 0.34 , suggesting a significant level of technology utilization in the implementation of TQM by department heads. The highest score, 4.27 ± 0.36 , was observed in the application of technology for implementing the community college performance results principle, while the lowest score, 2.26 ± 0.35 , was recorded in the use of technology for implementing the principle of Information and Analysis. The Mann-Whitney U test revealed that, compared to their male counterparts, female department heads declared using technology more often for leadership tasks such as administrative leadership, quality management, and public accountability ($p = 0.001$; $d_{\text{Cohen}} = 1.154$). For the implementation of the TQM principles of human resource development and management ($p = 0.038$; $d_{\text{Cohen}} = 0.539$), education and business process management ($p = 0.011$; $d_{\text{Cohen}} = 0.677$), and community college performance outcomes ($p = 0.034$; $d_{\text{Cohen}} = 0.539$), female department heads also reported using technology more frequently than their male counterparts. The use of technology in implementing leadership principles, information and analysis, and community college performance outcomes varied significantly by age and years of experience. In this regard, the corresponding p -values for age were 0.001, 0.005, and 0.036 and those for experience were 0.001, 0.006, and 0.036, respectively. The corresponding effect sizes for age were 1.086, 0.842, and 0.595, and for experience, they were 0.982, 0.819, and 0.597, respectively. Tables 2, 3, and 4 present the participants' scores pertaining to the utilization of technology in the execution of Total Quality Management (TQM). Except for the "leadership" principle, all other principles and the overall TQM score exceeded 3.32, suggesting a significant degree of technological utilization in the execution of TQM by department heads at Hail University. The results of the Mann-Whitney U test indicated that female department heads reported a higher frequency of technology usage by their direct senior managers for various leadership duties, including administrative leadership, quality management, and public accountability, in comparison to their male counterparts ($p = 0.001$; $d_{\text{Cohen}} = 1.154$). Female department heads demonstrated a higher frequency of technology usage compared to their male counterparts in the implementation of TQM principles of human resource development and management ($p = 0.038$; $d_{\text{Cohen}} = 0.539$), education and business process management ($p = 0.011$; $d_{\text{Cohen}} = 0.677$), and community college performance outcomes ($p = 0.034$; $d_{\text{Cohen}} = 0.539$). The utilization of technology in the application of leadership principles, information and analysis, and the achievement of community college performance outcomes shown notable variations based on age and years of experience. Regarding this matter, the p -values associated with age were found to be 0.001, 0.005, and 0.036, while the p -values associated with experience were 0.001, 0.006, and 0.036. The corresponding effect sizes for age were 1.086, 0.842, and 0.595, and for experience, they were 0.982, 0.819, and 0.597, respectively. In spite of their limited experience, it was observed that the department heads who were the youngest tended to employ technology more frequently in the implementation of TQM in a general sense ($p = 0.001$ for all; $d_{\text{Cohen}} = 1.189$ and 1.083) as well as in the application of the aforementioned principles, as indicated in Tables 3 and 4.

Pearson's correlation test results also demonstrated that the use of technology was important in the successful implementation of TQM and its various principles at the departmental level within Hail University (Table 5). It should be emphasized, however, that this association was not detected in respect to human resource development and management, as well as educational and business process management. Table 4 further shows that there was no statistically significant relationship found between the use of technology to improve the teaching and learning process and the implementation of strategic and operational planning.

Table 5.
Relationship between the type of technological tools and the implementation of TQM principles.

	Organization and management of the educational system	Satisfaction of certain additional needs of educational systems and educators	Realization of the 'teaching/learning' process.	Use of technology in general
Leadership	0.555**	0.499**	0.375**	0.541**
Information and analysis	0.401**	0.436**	0.295*	0.423**
Strategic and operational planning	0.472**	0.391**	NS	0.421**
Human resource development and management	NS	NS	NS	NS
Education and business process management	NS	NS	NS	NS
Community college performance results	0.436**	0.552**	0.298*	0.478**
Student focus and student and stakeholder satisfaction	0.647**	0.388**	0.397**	0.556**
TQM	0.708**	0.578**	0.509**	0.682**

Note: NS, not significant.

5. Discussion

This research aims to determine the extent to which technology has been used to support TQM at Hail University to determine the role of technology in TQM implementation. The primary research question was “To what extent does technology help in applying TQM at Hail University from the perspective of department heads? To address this question, the first research objective was to investigate the relationship between the use of technology and the degree to which TQM principles are put into practice in the various departments at Hail University. As is evident from the responses to questions of the first section of the questionnaire, most of the participants agreed that TQM aids in the enhancement of management functions and the achievement of the Saudi Vision 2030. Participants also agreed that integrating technology aids in the implementation of TQM in higher education. These findings are in line with those of Couch [20], al-Omouh, alrahahleh, & Alabaddi [38], Ravindran & Kamaravel [39], Borgia & Khan [40], Nasim, Sikander, & Tian [41], and Yusuf [42] who asserted that quality management can be streamlined and made more efficient with the help of technology.

The data about the integration of technological instruments in the implementation of TQM principles indicated an average value of 5.32 with a standard deviation of 2.12. Technology tools were primarily employed to facilitate the teaching and learning process ($M = 2.72$, $SD = 0.72$). Notable examples of such equipment were computers, video projectors, blackboards, university website, emails, Microsoft Teams, the Zoom application, and various social media platforms. The utilization of various technologies in organizing and controlling the educational system was ranked as the second most prevalent practice, with a mean score of 1.93 and a standard deviation of 0.97. Among the technologies employed, university website, iPads and Android tablets, Microsoft Teams, the Zoom application, and WhatsApp were found to be the most commonly utilized platforms. D'Angelo [43] asserted that when technology is used in the classroom, it can promote more democratic and adaptable approaches to teaching and learning, give students more autonomy and control over their education, and foster the growth of students' cognitive skills and knowledge. Introducing technology into the classroom promotes student learning in a variety of ways, including the application of prior knowledge, cognitive hierarchy, elaboration, depth of processing, and creative problem-solving [44]. This integration makes classrooms more student-centered by providing students with more control over their education [45]. Teachers also feel that if they are properly trained in professional digital competencies, they can assist students learn more effectively in the classroom using technology [46].

Numerous studies have also indicated that using technology in the classroom increases students' interest and excitement for learning [45]. The use of technology, in particular, increases students' behavioral (more effort and time spent participating in learning activities), emotional (positive impact on attitudes and interests toward learning), and cognitive (mental investment to comprehend content) engagement. When technology is employed in or out of the classroom, students have more opportunities to ask questions, work in groups, and actively participate in their education. Web-conferencing tools, blogs, wikis, social networking sites, and digital games are just a few of the technological tools that have been shown to boost student participation [47]. Moreover, using a variety of digital tools in the classroom improves students' capacity to think critically, communicate effectively, collaborate to solve problems, reflect on what they've learned, and enhance their digital literacy [47]. According to research, students who were taught using technology enhancements (such as lecture recordings and podcasts) outperformed those who were taught without such resources. Students who learned the identical subject in a classroom with technology upgrades outperformed their colleagues who learned in a regular classroom setting, according to the findings [48]. All objective measures, including papers, midterm/final exam scores, and individual tasks, revealed that the intervention group performed better.

Our findings also demonstrated that technology could support the seven quality management dimensions in higher education. The highest score, 4.27 ± 0.36 , was observed in the application of technology for implementing the community college performance results principle, while the lowest score, 2.26 ± 0.35 , was recorded in the use of technology for implementing the principle of Information

and Analysis. This is consistent with the conclusion of Hernandez-Jover, Campbell, & Rutherford [49] that technology significantly improves the overall efficacy of quality management. One of the most important benefits of technology is its ability to improve departmental communication and collaboration. Using technological tools, department heads can easily communicate with one another, share information, and provide feedback [43]. This can help ensure that all departments are on the same page and are working toward the same goals. Technology can also be used to speed up administrative processes, increasing productivity and efficiency. Department chairs can employ technology to monitor student progress, manage course schedules, and perform administrative tasks such as budgeting and resource allocation. This will free up department heads' time for curriculum development and student engagement [50]. Furthermore, technology can be used to improve instruction and learning outcomes. Department leaders can provide students with a more engaging and interactive learning environment by utilizing technological tools such as online learning platforms, educational software, and virtual reality. These tools can also help students customize their learning experience and track their progress, thereby increasing their motivation and engagement [51]. According to Todorut [52], the implementation of TQM in universities is heavily influenced by "institutional culture," which "influences the application procedures in the context of quality strategies." Aside from that, institutional culture assists universities in integrating beneficial values, beliefs, and behavioral norms that can shape the student experience.

Our results also revealed significant differences in the use of technology by Hail University department heads in implementing TQMA. Female participants exhibited relatively higher use of technology than male participants, whereas the younger generation exhibited higher use of technology than the older generation. Several previous studies have reported that demographic factors such as age, years of teaching experience, education level, and gender impact the integration of technology in universities, mainly in teaching and learning. According to a study conducted by Blackwell, Lauricella, & Wartella [26] (2014), teachers with greater experience have less favorable attitudes toward technology use and, as a result, employ technology less frequently in their classrooms. This is also in line with studies by Karaca, Can, & Yildirim [53] and Shiboko [25], all of which reported that teachers with less experience are more likely to use technology in their classes than teachers with more experience. This was attributed to the fact that younger teachers, unlike their counterparts, were trained in the era of technology and are thus more knowledgeable and skilled in the use of modern technology. Shiboko [25] further reported low levels of skills, interest, and use of computers among females due to limited access to technology. Further, according to an earlier study by Kay [54], male teachers used technology more than their female counterparts. This disparity may be attributed to female participants' younger age (40.5 ± 5.8 vs. 46.9 ± 6.44 years) and their desire to assert themselves in a patriarchal society, particularly when seeking social and academic opportunities through active participation [55]. Furthermore, studies have shown that while educational level does not influence the use of technology, technical training does play a role in it.

6. Limitations and Implications

Our findings should be interpreted with certain research limitations in mind. First, the values recorded and analyzed were solely based on self-reported data from department heads. As a result, recall bias and social desirability outcomes cannot be ruled out. Recall bias arises when contributors forget facts, numbers, or frequencies. The potential of recollection bias, however, might be diminished by asking participants about their regular or everyday activities. The anonymity of this study also served as a hedging measure for department heads. Second, we used a questionnaire with closed questions to evaluate Hail University's TQM technology initiatives. Open-ended questioning techniques, such as in-depth interviews, have the potential to elicit much more detailed responses. Third, only department heads' perspectives were collected in this study; however, interviewing all parties involved in the implementation of TQM (deans, administrators, staff, and students) may provide a more complete and accurate picture of TQM at this university. Finally, because TQM was only recently introduced at Hail

University, conducting further studies that determine the obstacles affecting the implementation of TQM at Hail University will provide useful information and complement the findings of this study.

Despite the above-mentioned limitations, the results of the present study provide useful pointers for senior managers at Hail University on the importance of integrating TQM principles into all areas of the institution, and on the value of using technology to this end. There is an urgent need to place greater emphasis on the technological tools used, as their current capabilities are deemed insufficient [56]. In addition, it is essential to provide specific training for the most senior department heads.

7. Conclusions

The findings of this study indicated that technology plays a significant role in the implementation of TQM at Hail University. The department heads largely agreed that the integration of TQM can help in improving organizational performance. Thus, it is highly effective in a university setting. Additionally, it can also be concluded that the implementation of TQM has become an important aspect of the field of education. This is because it significantly improves the efficiency of the administration and management of the university. Furthermore, this study also noted significant differences in the use of technology by Hail University department heads in their implementation of TQM. Overall, females outperformed males, and the younger generation outperformed the older generation.

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