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Investigation for utilization of training resources in technical education: A comparative study

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ABSTRACT

This research study presents a comparative study between the quarter and the semester systems in the technical institutes, in terms of scheduling, training, and utilizing the training resources such as classrooms/halls capacity and employing the instructors. The size of the study sample was represented by the total number of students in classrooms/halls for the study courses in the quarter system by 8836 students distributed over 363 sections. While in the semester system 10360 students distributed over 358 sections. Thus, a comparison was made based on one training year between the two training systems for basic skills courses. The samples were used to know the effect of class capacity and teaching loads on the training system by making initial comparisons, and statistical tools were used where averages of class capacity and teaching loads were calculated to know the status and trends of the data using the plot box. In addition to descriptive statistics (Two samples F-test for variance) and finally, (t-test: Two samples assuming unequal variance) were selected. The p-value less than 0.05 of single-tailed confirmed that classroom capacity and instructors' load were higher in the semester system compared to the quarter system.

1. Introduction

The technical institutes provide a high level of specialized technical training in various technical fields, such as electricity, mechanics, information technology, operation, and other skills. In Asian countries such as China and Japan, the education system has adopted a more practical and technical approach to learning whereby scholars are exposed to technology and inventions at an early age. On the other hand, the European education system focuses on the quality of education particularly in vocational and educational fields as well as in citizen-building (Beharry-Ramraj et al., 2020). The technical institutes provide the training services intending to prepare national cadres that are scientifically, practically qualified, and with highly professional skills, to carry out operation and maintenance work in different plants and companies. The trainees are admitted to these technical institutes after obtaining the general secondary school certificate or its equivalent as a basic condition for admission to these institutes. Trainees gradually trained from their admission to the institute throughout two semesters. These institutes are distinguished by the provided great support by governments. In general, these institutes greatly assist in increasing employment and reducing unemployment rates because of their proximity to the requirements of the labor market. The private institutes also work to raise the quality of their training services and meet the requirements of their customers in general. The graduate employment rate shows how graduates are absorbed into the labor market due to their increased employability via training and education (Joo, 2018). Technical institutes work on competency-based training systems. Which is known as training in skills with specific detailed tasks in the form of small subtasks carried out by the trainee to obtain the required skill. The different training periods include different assessment systems to measure the obtained skills, and the trainee gradually develops skills acquisition. Assessing the impact of participation in an institute-to-work

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system on student performance provides practitioners the opportunity to examine whether or not their system is providing trainees with the skills required for academic and lifelong success. Usually, the training period in technical institutes takes about two years in addition to a period of practical application in the real work environment, and by the end of the training period, the trainee is qualified to work as a qualified technician/operator in the industrial or service sector. This type of training has proven its efficiency according to the recommendations of local and international employment agencies. Coop training primarily focuses on sustainable relationships between institutes/universities and plants/companies for the benefit of an enriched curriculum for students. The difference between coop training and short periods of work experience and internships is based on the idea that the trainee has the status of an employee, with a regular salary, making part of the working community (Kessels and Kwakman, 2007). These training systems are as diverse as the semester system or quarter system to complete the full training in the required skills. The implemented academic system affects the quality of the outputs of these technical institutes. In Jubail Industrial City, many private companies are running in the petrochemical and other industrial fields. These companies and plants attract qualified national professionals, and the institutes must link their training courses and curricula with the available jobs in these companies. In addition to that, the work at these companies requires obtaining a certain degree of skills which requires technical institutes to link their training courses and curricula to these jobs and their changing needs. The used training system whether the semester system or the quarter system in technical institutes affects the fulfillment of the requirements of plants and the quality of the outputs of these institutes. The institutes aim to obtain the return from investment spent on devices and equipment, by training and graduating the largest number of qualified trainees to meet the requirements of the labor market. Training in the institutes varies between the semester system and the quarter system. In the semester system, the academic year is divided into two main semesters, and each semester consists of fifteen weeks in addition to the final exam period. While the quarter system is divided into four basic training periods, the duration of one quarter is eight weeks, every week five training days, and every day six training hours, and separates between each quarter and another one a week. Each of the two systems has different characteristics from the other and different effects on the training environment in general. Since the formation of the training's load is an integral part of the preparation to forming a schedule, as the formed load represents disciplines split into classroom sessions, distributed among cohorts or subgroups, and it also establishes the connection of each session with the trainers (Khoroshko and Vikulin, 2020). This research examined the training capacities in classes/halls and the teaching loads of the trainers. The operation efficiency in the technical institutes plays a major and essential role in providing resources and legalizing their spending. It is one of the most important goals of the technical institutes, as the institutes require the provision of large sums of money for training in the latest equipment and devices that are constantly and rapidly developing according to the needs of the industrial sector. Certainly, the institutes aim to obtain the return from investing these spent monies on the new equipment, throughout graduating the largest number of qualified trainees to meet the requirements of the labor market. The least attention is given to the cost of quality of technical education. Today the cost of technical education is increasing rapidly. Nobody is giving attention to losses of funds due to the failure of students in examinations (Akhade and Jaju, 2009). Technical institutes also work on managing resources and budgets to cover training expenses and rationalize their consumption in the best way, by improving training methods for trainees. On the other hand, one of the most important elements to be the focus of education reform in the world is institutions governance, which emphasizes how to define goals, implement them, manage institutions, and monitor achievement in institutions and education systems. The broader and often used definition of institutions governance begins with an interesting attraction between the three main elements of governance: the state, the business community, and civil society (Lieharyani et al., 2020; Solangi et al., 2018). In the lower level, Especially in scheduling training sessions and using training resources such as halls, workshops, classrooms, laboratories, and the instructors to come out with the best possible operating conditions, and developing training systems to improve the work environment and increase efficiency. As it appears in the subject of this research. Throughout the system and by providing the needs of every aspect; including customer satisfaction, quality of services produced, cost-saving, employee benefit, working environment, and the impact of the organization's operations on the society (Al-githami and Esmail, 2020).

2. Background

Scheduling in training operations is the process of arranging, monitoring, and managing training resources such as the capacity of classes and halls, and managing the teaching loads of the trainers in a manner that allows them to reach the best desired results. Resource scheduling is an important component of overall system operations in high-performing service organizations (Hopp et al., 2009). For example, researchers present several integer programming models for an optimal assignment of tasks to workers for different objective functions such as minimizing the total training cost, minimizing the total training time, maximizing the workforce flexibility, and optimizing the trade-off

between workforce flexibility and training costs (Stewart et al., 1994). Scheduling in training has many benefits, for example, the ease of changing training schedules and reducing the costs of changing schedules, reducing the inventory of the used training resources, especially in the practical aspect, increasing the efficiency of training operations, accuracy in planning, and calculating dates for graduation, and reducing scheduling efforts in different training plans such as instructors, halls …etc. in addition to the benefits of providing information at any time about the status of the training process and the status of resources in the training system. The benefits of resource flexibility may be more substantial in parallel systems with less excess capacity, it notes that a larger production requirement does not appear to require higher cross-training levels among staff (Kim and Nembhard, 2013). The scheduling processes in the academic semester system differ from the quarter system in the elements, features and the inputs of each system differ from the other. These differences were taken into consideration when comparing the two systems in this study. Usually, scheduling inputs are addressed before approaching scheduling methods in training, to study the performance criteria and indicators, which help to know the capacity of classes/halls and use of them, in addition to the good use of available training cadres. Traditional classroom culture is grounded upon the concept that the training cadres are the most important stakeholder in the teaching and learning process by the virtue of her/his "knowledge" (Kalyanamitra et al., 2020). The patterns of demand for training services also constitute an important input to training scheduling processes. The available capacity of training resources is also a component of scheduling inputs. Instructors' schedules and student schedules act as a key to the entire training process and scheduling. As for the overlap of operations, it is one of the most important elements that aim to reach the maximum levels of resource utilization, while providing the necessary flexibility, as in the semester training system. Administrative can provide the institution with flexibility in meeting state or local requirements (e.g., the best ways to demonstrate graduation readiness, credit fulfillment, and seat-time requirements) and in scheduling to allow for longer learning blocks and instructor collaboration within teams and departments (Hernández et al., 2019). Scheduling operations in training can also be classified into two types: Backward scheduling, as in the institute's diploma and fixed training system, unlike forwarding scheduling, which is applied in the operations of special training programs and short courses, as it depends on the inputs and elements of training and how to manage them according to the type of the used training system, whether the training system was semester or quarter. Once the backward scheduling is completed, the forward scheduling is performed in the order of start times that are obtained in backward scheduling (Sonmez and Uysal, 2015). The scheduling of training resources aims to allocate the necessary training resources, tools, and to employ trainers, technicians. In addition to purchasing the required training materials in case of practical classes as an example. The scheduling of training resources also aims to rationalize consumption and increase the effectiveness of the used training processes and procedures to increase the training efficiency of the institute based on a basic training system such as the semester system. Scheduling training operations help in determining when to use external training resources such as external trainers or external halls when needed, in addition to external training companies, which can be collaborated with to implement a special training program. Scheduling affects the costs of attracting training resources as the costs of these resources change at the time of requesting these resources, taking into account the training capacities of the classes, halls, and the available instructors for the implementation of the training operations taking into account the current teaching loads of the trainers, which are usually determined by the contact hours in the week. Scheduling also affects the semester system to reduce the preparation times for training operations, which leads to the provision of resources that can be used later. Training in Training Devices is less costly to the student and provides a safer training environment than an actual machine, especially during particular course modules. As well, Training Devices activities are not canceled due to weather (in most cases) and require less personnel to maintain. These factors certainly have a significant impact on the practical application of the scheduling policies (Liu and Findlay, 2014). The impact of training clients from companies and institutions on scheduling training resources such as training classes and halls has a great impact in terms of the flexibility of the ability to change these plans in response to customer requirements, taking into account the change in these training resources and reducing costs. To improve the quality of training and adherence to the due dates of customer requirements. Usually, when reviewing customer requirements, training resources are referred to, such as the capacity of classes and halls, and their ability to accommodate the maximum number of trainees in addition to the teaching loads of trainers, before approving client requests and scheduling them. Taking into account setting the margin for unexpected events to increase the flexibility of schedules. This effect changes based on the user training system, whether the academic system is semester or quarter, according to its length or shortness, and the availability of trainers during the academic year in each system. Training facilities are key personnel practices of management in the current economic situation, which lead to skills, capabilities, higher knowledge, positive attitudes, and behavior of staff resulting in the profitability of the companies (Kalyanamitra et al., 2020). Therefore, the impact on the quality and cost of training services affected by the change in the

capacity of classrooms and halls and the teaching loads of trainers, which is evident in terms of the utilization of training resources while maintaining the quality of training services. This changes between the training systems, either the semester system or the quarter system. The more exploitation of training resources, the less the cost of the provided training services, and thus the more efficient investment and financial resources provided. Therefore, Designing high-quality learning experiences is a purposeful and deliberate process that draws from many disciplines and professions, including education, cognition, psychology, instructional design, and training, needs assessment, assessment, and program evaluation. The processes are complicated by the context(s) in which the learning will take place, the desired goals of the learning, the reason(s) for the learning, and more (LaVelle et al., 2020). The importance of quality in the technical institutes would come from the need of raising the efficiency of the operation to graduate the largest number of qualified trainees, for the sake of meeting the requirements of the changing labor markets (Al-githami and Esmail, 2020).

The Jubail Technical Institute (JTI) is one of the most important training institutes in the Kingdom of Saudi Arabia, as it has the support of the Royal Commission for Jubail and Yanbu across the education sector. JTI seeks to achieve its mission in training the national workforce in the technical fields to meet the needs of the industrial sector. JTI qualifies technicians who are effectively trained to deal with up-to-date industrial technology. The institute has highly qualified staff and faculty members to achieve its vision. JTI aspires to be the standard of excellence in the field of technical training and small and medium enterprises in all Arab Gulf countries. The institute obtained institutional accreditation from the National Center for Technical and Vocational Accreditation and Assessment under the Education and Training Evaluation Commission. As one of the first training institutes to obtain this accreditation in the Kingdom. The institute offers training on a range of different skills such as industrial electric skills, instrumentation and control, industrial electronics, process operation skill, industrial millwright, industrial welding, machining skills, CADD skills, crane operation skills, computer network, and PC support skills and underwater maintenance training program. The training at the institute extends to two and a half years so that is the first year for basic skills that include studying English. The trainees move to one of the specializations to train for a full year. The trainee is then eligible to apply what he trained in public and private companies and institutions. JTI average admission in the academic year (≈1200 trainees). A wide range of services is provided, such as housing, subsistence, health services, and others. Several years ago the institute's training system was changed from a quarter system to a semester system to improve the training environment and operating conditions and development. JTI has several electronic software systems such as the Student Information System (SIS), in which training sessions are scheduled by using the available resources, and all students' academic data such as grades and other data can also be recorded. Table 1 shows the degree plan of the basic skills year according to the quarter system.

Table 1: Degree plan of the basic skills year according to the quarter system

Quarter	Course Code	Contact Hours	Total Contact Hour
Quarter 1	1. BSEL103	160	240
	2. BSPE101	32	
	3. BSTD103	48	
Quarter 2	1. BSEL204	160	256
	2. BSHS201	32	
	3. BSIC201	32	
	4. BSKB201	32	
Quarter 3	1. BSEL305	160	272
	2. BSCD304	48	
	3. BSCA303	64	
Quarter 4	1.BSEL406	160	272
	2.BSTM401	48	
	3.BSWP401	64	

JTI carried out the experience of training with a quarter system and the semester system and concluded that many results based on practical experience and studies, including that the length of training which is in semester system is more appropriate for the trainee in terms of achievement and the reaction between the trainee and the trainer, in contrast to the quarter system, as in Table 1 Degree plan of the basic skills year according to the quarter system. Regardless of the used training system, scheduling is preferred in the parallel horizontal format in most courses, with few exceptions. Depending on the availability and class capabilities, the semester system provides the opportunity to view the full courses, so the chances of lateness students behind are less than in the quarter system. Moreover, there is a clear difference regarding tackling the issue of a training schedule. Table 2 shows the degree plan of the basic skills year according to the Semester system.

When the institute moved from the quarter system to the semester system, the number of hours of courses has been studied, training programs have been modified, contents have been revised, and modern curricula have been designed to fit the semester system as in Table 2 Degree plan of the basic skills year according to the quarter system. JTI has many local and international accreditation

programs and test centers for all the different skills that fall under the departments; the basic skills department, the electrical and electronic department, the mechanical skills department, the chemical skills department, the computer and information technology skills department.

Table 2: Degree plan of the basic skills year according to the Semester system

Semester	Course Code	Contact Hours	Total Contact Hour
Semester 1	1.BSEL 1407	300	435
	2.BSTD 1404	45	
	3.BSHS 1402	30	
	4.BSIC 1402	30	
	5.BSPE 1402	30	
Semester 2	1. BSEL 2408	300	510
	2. BSCA 2404	60	
	3. BSTD 2405	45	
	4. BSWP 2402	60	
	5. BSTM 2402	45	

JTI provides many different training services, such as special training programs, short training programs, technical evaluation services, and other services. This is based on huge training resources which vary from equipped workshops/laboratories, in addition to the halls and classrooms with the latest equipment to the nearest location with the industrial sector. The Institute also possesses global competencies and experiences from faculty members and trained cadres at the highest levels.

3. Research objective

This study aims to compare the quarter and the semester systems in terms of scheduling in training using available training resources such as the capacity of classrooms and halls and the utilization of the instructors. Emphasizing the preference of the semester system over the quarter system in terms of preference use of resources and ensuring efficient operation. The study also presents the semester system as one of the solutions to develop the use of training resources compared to what was applied before through the previous quarter system.

4. Methodology

The data of capacity of the classes and halls were collected in the quarter system of a full academic year, representing four training quarters, distributed between the first half of the year 2013 and the second half of the same year. The size of the sample represented by the total number of students in the classes and halls for courses in the quarter system was 8836 students, distributed over 363 sections. This sample of sections was compared with the data of the capacity of the classes and halls in the semester system for a full academic year, representing two semesters, distributing between the first half of the year 2016 and the second half of the same year. The total sample number in the training classes and halls for courses in the semester system was 10360 students, distributed over 358 sections. Thus, the comparison is made based on one training year between the two training systems, for the courses of the basic skills year. The data of the teaching loads of the instructors in the quarter system was also collected for a full academic year, and the total sample of the teaching loads of the instructors in the quarter system was 163 teaching loads, distributed over four training quarters in the year 2013 as follows 34, 42, 39, 48 teaching loads. This sample of the quarter system was compared with the teaching loads data in the semester system in 2016 is as follows 45, 50 teaching loads. Thus, the comparison is made based on one training year between the two training systems, for the courses of the basic skills. It was taken into consideration not to use overlapping data between quarter and semester systems during the institute's transition from one system to the other.

After collecting the capacity of the classes and halls and the teaching loads data in the quarter system, it was used as a sample to compare them with the capacity of classes and halls in the semester system. To find out the effect of the class capacity and the teaching loads on the training system. After making the initial comparisons, we have transferred to the statistical tools by collecting all the data of the capacity of the classes and halls in the semester system and the quarter system separately, to test the hypothesis of the study and confirm the results. Moreover, the averages of the classes' capacity and the teaching loads were calculated to know the trend and directions of the data, then we moved to the box plot to review the data visually, in addition to descriptive statistics to understand the nature of the data statistically for both systems for comparison. Then the (F-Test Two-Sample for Variances) was used to determine whether Variances are equal or not, to determine which type of hypothesis test can be applied. Finally, (t-Test: Two-Sample Assuming Unequal Variances) was chosen to test the hypothesis of the study and conclude the test results which would come later.

5. Results

5.1. The average capacity of classrooms and halls

The average height of the classrooms and halls in the semester system looked clear as in Fig. 1, as the average capacity of the classrooms and halls exceeded 29 students in the semester system. While the maximum average capacity for classes and halls in the quarter system reaches 25 students. This

enhances the preference of the semester system by utilizing classrooms to fill them with students to rationalize training resources and good management.

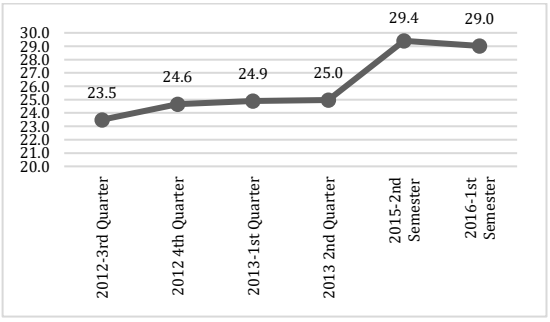

Fig. 1: Average of classes' capacity of students

In Fig. 2, the important statistical aspects of the capacity of classrooms and halls in the taken samples were calculated for both the quarter and semester systems to compare them with each other. The box plot tool was used to summarize the most important statistical characteristics of the frequency distribution for easy understanding and comparison. It gives information about where the data falls and how far it spreads and can be seen on the plot. It divides the class capacity data for each quarter or semester into four groups, mediating these groups the median, which is separated by two groups. It is evident from Fig. 2 that the higher class capacities appear in the last upper group in the case of the semester compared to the quarter system. The high-class capacities were in the first half of 2016 and the second half of 2015. On the other hand, the third group in the semester system is larger than the third group in the quarter system. Accordingly, the move was made to the known statistical methods for the final judgment on the preference of class capacities in the semester system over the quarter system.

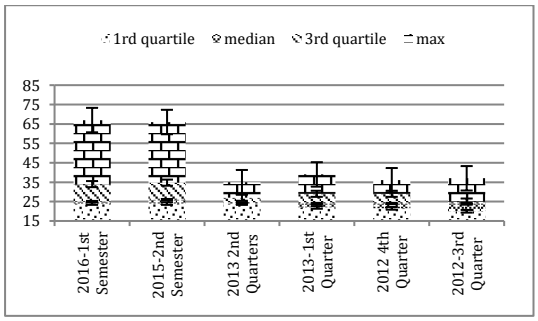

Fig. 2: Box plot of the statistical properties of classes capacity of students

Descriptive statistics were used to know the nature of the samples and the results were as shown in Table 3, by statistically identifying the samples for each of the class capacities in the quarter system and the semester system. Where the class capacity in the quarter system is represented by 363 classes, while the class capacity in the semester system is represented by 358 classes. The average class capacity in the quarter system was about 24 trainees/class, while the average class capacity in the semester system was about 29 trainees/class. It is noted that the average capacity of the classes in the semester system is higher than the average capacity of the classes in the quarter system. This in turn confirms the optimum utilization of available resources by accommodating the largest number of trainees in the classroom or hall.

Table 3: Descriptive statistics of the classes' capacity of students

Quarter		Semester	
Mean	24.342	Mean	28.939
Standard Error	0.292	Standard Error	0.508
Median	24	Median	25
Mode	24	Mode	24
Standard Deviation	5.566	Standard Deviation	9.599
Sample Variance	30.977	Sample Variance	92.137
Kurtosis	0.598	Kurtosis	2.778
Skewness	-0.321	Skewness	1.182
Range	33	Range	64
Minimum	6	Minimum	3
Maximum	39	Maximum	67
Sum	8836	Sum	10360
Count	363	Count	358

Referring to the question and hypothesis of this study, "Does the classes capacity are greater in the semester system compared with the quarter system?" Test at α=0.05.

- The null hypothesis would be=H_0: μ_S-μ_Q<=0.
- The alternative hypothesis would be=H_1: μ_S-μ_Q>1.

The F-Test two-sample for variances was used to decide whether to conduct t-Test for two-sample assuming equal variances or t-Test for two-sample assuming unequal variances.

From Table 4, the one-tail p-value is usually multiplying by two to obtain the two-tail p-value and it is small enough to tell us there is a significant difference in population variances. That aside, we also see here there is a clear difference between the two variances. Therefore, the decision made to conduct t-Test: Two-sample assuming unequal variances.

Concerning the results in Table 5, the one-tail critical value as a right-tail test, the null hypothesis would be rejected if the t statistic is greater than positive 1.648. While the test statistic is 7.853. Based on that, we decided on whether or not to reject the null hypothesis. Since the t statistic is 7.8525 is greater than 1.6475. So we do reject the null

hypothesis. In addition to that, we can see that the one-tailed p-value is far smaller than 0.05, telling us again to reject the null hypothesis. As a result, we supported the alternative hypothesis. That is, there is enough evidence to conclude that the class capacity is greater in the semester system compared with the quarter system, and that concludes the test.

Table 4: F-Test two-sample for variances–classes capacity

	Semester	Quarter
Mean	28.939	24.342
Variance	92.137	30.977
Observations	358	363
df	357	362
F	2.974	-
P(F<=f) one-tail	2.795×10^{-24}	-
F Critical one-tail	1.1897	-

Table 5: T-Test: Two-sample assuming unequal variances–classes capacity

	Semester	Quarter
Mean	28.939	24.342
Variance	92.136	30.977
Observations	358	363
Hypothesized Mean Difference	0	-
df	571	-
t Stat	7.853	-
P(T<=t) one-tail	1.014×10^{-14}	-
t Critical one-tail	1.648	-
P(T<=t) two-tail	2.028×10^{-14}	-
t Critical two-tail	1.964	-

5.2. The average training load for trainers in the semester and quarter system

From Fig. 3 It is clear that the average teaching loads of trainers in the semester system exceed 21 training hours per week. Whereas in the quarter system, the maximum reached to 20 training hours per week. This shows the preference of the semester system in terms of utilizing the capabilities of the training staff to the maximum possible extent.

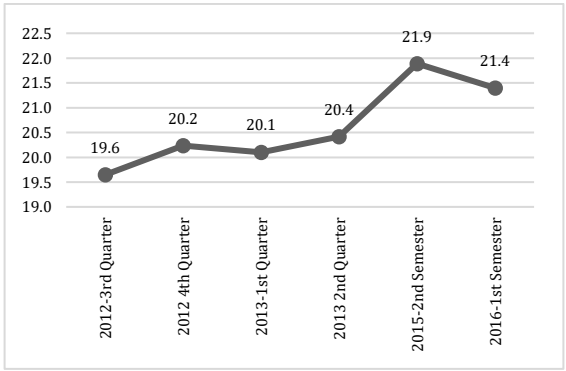

Fig. 3: Average of teaching loads of instructors

In the same way, the important statistical properties of the teaching loads of instructors in the taken samples, whether for quarter or semester and were calculated to understand and compare them with each other as in Fig. 4. The box plot tool has been used, from Fig. 4, the higher teaching loads appear in the last upper group in the case of the semester system more clearly compared to the quarter system. The highest teaching loads were in the second half of 2015, the first half of 2016, and in the third quarter of 2012. The disappearance of the second and third groups almost cleared, and approximately the accumulation of data in the first and fourth groups. Accordingly, the transition to the known statistical methods was made to judge the final advantage over the optimal use of the teaching loads of instructors in the semester system over the quarter system.

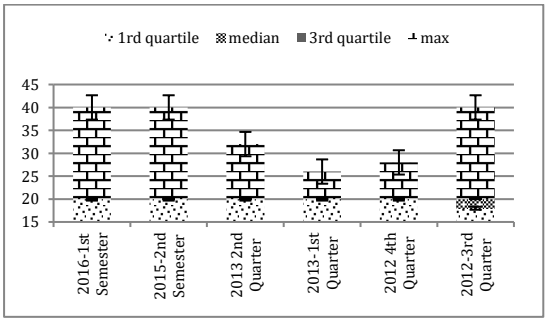

Fig. 4: Box plot of the statistical properties of teaching loads of instructors

With the previous method, descriptive statistics were used to identify the samples and the results were as shown in Table 6. Where the teaching loads of instructors appear in the quarter and semester system. Where the teaching loads of instructors in the quarter system are represented by 163 teaching loads or trainers' schedules while teaching loads of instructors in the semester system are represented by 95 teaching loads or trainers' schedules. The average teaching loads in the quarter system were 20.1 training hours per week, while the average teaching loads in the semester system were 21.6 training hours per week. It is noted that the average teaching loads in the semester system are higher than the average teaching loads in the quarter system.

Referring to the second question and hypothesis of this study,

Does the teaching loads of instructors are greater in the semester system compared with the quarter system? Test at α=0.05.

- The null hypothesis would be=H_0: $\mu_S-\mu_Q<=0$
- The alternative hypothesis would be=H_1: $\mu_S-\mu_Q>1$

Table 6: F-Test two-sample for variances–teaching loads

Quarter		Semester	
Mean	20.135	Mean	21.632
Standard Error	0.252	Standard Error	0.624
Median	20	Median	20
Mode	20	Mode	20
Standard Deviation	3.221	Standard Deviation	6.086
Sample Variance	10.376	Sample Variance	37.044
Kurtosis	9.732	Kurtosis	2.012
Skewness	1.63	Skewness	1.35
Range	28	Range	28
Minimum	12	Minimum	12
Maximum	40	Maximum	40
Sum	3282	Sum	2055
Count	163	Count	95

The F-Test two-sample for variances was used to decide whether to conduct t-Test for two-sample assuming equal variances or t-Test for two-sample

assuming unequal variances. From Table 7, the one-tail p-value is usually multiplying by two to obtain the two-tail p-value and it is small enough to tell us there is a significant difference in population variances. That aside, we also see a clear difference between the two variances. Therefore, the decision was made to conduct a t-Test: Two-sample assuming unequal variances.

Table 7: F-Test two-sample for variances–teaching loads

	Semester	Quarter
Mean	21.631	20.135
Variance	37.044	10.377
Observations	95	163
df	94	162
F	3.57	-
P(F<=f) one-tail	5.844×10^{-13}	-
F Critical one-tail	1.344	-

With the previous procedure and from the results in Table 8, the focus was on the one-tail critical value as a right-tail test, the null hypothesis would be rejected if the t statistic is greater than positive 1.657. While the test statistic is 2.222. We look at the results to decide to reject the null hypothesis or not. Since the t statistic was 2.222 which is greater than 1.6457. We do reject the null hypothesis. In addition to that, the one-tailed p-value was smaller than 0.05, which guided us also to reject the null hypothesis. As a result, we have supported the alternative hypothesis. That is, there is enough evidence to conclude that the teaching loads of the instructors are greater in the semester system compared with the quarter system, and that concludes the test.

Table 8: T-Test: Two-sample assuming unequal variances–teaching loads

	Semester	Quarter
Mean	21.632	20.135
Variance	37.044	10.377
Observations	95	163
Hypothesized Mean Difference	0	-
df	125	-
t Stat	2.222	-
P(T<=t) one-tail	0.014	-
t Critical one-tail	1.657	-
P(T<=t) two-tail	0.028	-
t Critical two-tail	1.979	-

6. Conclusion

From the previous study, it is clear that the capacities of the classes/laboratories and the teaching loads of the instructor in the semester system are higher than the quarter system. Where the capacities of the classes/halls were higher than their counterparts in the quarter system. Specifically, the capacity of the halls exceeded 65 students in the hall as in Fig. 2.

This can be an indicator of the better use of the halls for theoretical training in the long semester system compared to the relatively short quarter system. In addition to that, it appears that a group of the data for the highest max of the capacity of halls in the semester system ranges between a large range which is 67-35 students in the hall, compared to a group of the data for the highest capacity for halls in the quarter system, which appear on a narrower range between 39-23 students in the hall. From the same Fig. 2, the third quartile appears in the semester system in the range of 35-25 students in the hall, while in the quarter system the third quartile appears in a smaller quartile and ranges between 30-23 students in the hall. This confirms the preference of the semester system in training compared to the quarter system regarding the exploitation of the capacities of classrooms and halls. It is noticed that an increase in students' capacity in the halls and classrooms, after the institute shifted from the quarter system to the semester system by 19%, as an increase in the average student capacity in the halls. As the highest capacity of students in the halls in the semester system reached 67 students in the hall, while the highest capacity of students in the halls in the quarter system is only 39 students per class.

From Fig. 4, it notes that the maximum teaching loads in the semester system-in the two understudy semesters were 40 hours per week, compared to the quarter system where it did not exceed 35 hours per week, except for the 3rd quarter of the year 2012, which is reached 40 hours per week as well. The stability of the first group of the sample data also appears at 20 hours per week in most of the study samples for both systems, the semester system, and the quarter system. Except for the 3rd quarter of the year 2012. As for the average teaching loads, it increased in the semester system to 7%, after the institute shifted from the quarter to the semester system.

The increase in the capacity of classes, halls, and the teaching loads of instructors, resulting from the shift to the semester system. In addition to several factors, including the length of time for the semester system over the quarter system. The semester system provides better use of the workshops due to the use of more than one group in the classes inside the workshop. The scheduling process is different in its ease of theoretical from the practical classes, while the office times of the trainer throughout the week are more appropriate for use in the preparation of others training duties, all of these factors in contrast quarter system.

If we compare the results of this study with what Joo (2018), concluded in his published paper, where can reach similar results that the educational institution requires different strategies to improve educational and training performance according to the level and the type of education. However, the way in which the factors affect the results and the main factor determining the results varies according to the level and type of provider.

Through the test of the hypothesis that the semester system increases the utilization of training resources (the capacity of classrooms/halls and the teaching loads of instructors) better than the quarter system, which has been statistically and through graphs were confirmed. The Institute has undertaken several initiatives to increase the

utilization of training resources more than that, like the following:

- Development of the scheduling system in training and the use of training resources is one of the most important motives that led to changing the training system in the institute from a quarter system to a semester system.
- The institute has carried out many studies to develop scheduling processes, starting with pilot studies and testing their results to generalize them further, as is the case in adopting the semester system as a new training system.
- Before the start of the actual implementation of the new scheduling processes, staff and students have been educated and trained through several methods to start the new long semester system to reduce unwanted results during implementation processes.
- Several training procedures accompanying scheduling processes have been developed based on the semester system in terms of student attendance and other procedures.
- Electronic systems have been developed to greatly facilitate scheduling and link the use of student information systems to scheduling data to ease the experience of users and increase their satisfaction rates.
- The Institute has also linked, updated, and developed the curricula to optimize the use of training resources based on the new semester system and its new scheduling processes.
- The competency-based training system requires scheduling to take into account the importance of arranging scheduling elements in a specific way relative to practical and theoretical training sessions and interventions between them as it was developed in the new semester system.
- Scheduling services for users is one of the most important scheduling processes that have been taken into account in the new semester system, as operations sometimes require changing the instructor's schedule or student's schedule based on the specific authority that is developed in the new semester system.
- The feedback processes on the new semester systems help in developing the optimizing of the use of training resources. Consider as the most crucial necessary development processes that give the institute the necessary confidence and result from the opinions of the users of the new scheduling services in the semester system. This feedback works to develop the scheduling process to achieve the maximum degrees of use of resources, taking into consideration the improvement of the work environment.

Finally, throughout the experience of Jubail Technical Institute, the previous and other studies, the semester system is considered the best system in terms of utilizing training resources and improving a wide range of training performance indicators that will be addressed in future studies.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Akhade GN and Jaju SB (2009). Development of methodology for collecting quality cost in technical institute. In the Second International Conference on Emerging Trends in Engineering and Technology, IEEE, Nagpur, India: 798-801. https://doi.org/10.1109/ICETET.2009.82

Al-Githami SS and Esmail AHM (2020). Impact of the integrated management system on the employees' satisfaction rate in the technical institutes. Journal of Advances in Education and Philosophy, 4(2): 60-69. https://doi.org/10.36348/jaep.2020.v04i02.005

Beharry-Ramraj A, Amolo J, and Mashau P (2020). Structural adjustment for South African technical and vocational education and training (TVET) colleges capacitation. Gender and Behavior, 18(1): 14605-14620.

Hernández LE, Darling-Hammond L, Adams J, and Bradley K (2019). Deeper learning networks: Taking student-centered learning and equity to scale (Deeper learning networks series). Learning Policy Institute, Palo Alto, USA.

Hopp WJ, Iravani SM, and Liu F (2009). Managing white-collar work: An operations-oriented survey. Production and Operations Management, 18(1): 1-32. https://doi.org/10.1111/j.1937-5956.2009.01002.x

Joo L (2018). Vol. 2: The excellence of technical vocational education and training (TVET) institutions in Korea-Case study on Busan national mechanical technical high school. International Education Studies, 11(11): 69-87. https://doi.org/10.5539/ies.v11n11p69

Kalyanamitra P, Saengchai S, and Jermsittiparsert K (2020). Impact of training facilities, benefits and compensation, and performance appraisal on the employees' retention: A mediating effect of employees' job satisfaction. Systematic Reviews in Pharmacy, 11(3): 166-175.

Kessels J and Kwakman K (2007). Interface: Establishing knowledge networks between higher vocational education and businesses. Higher Education, 54(5): 689-703. https://doi.org/10.1007/s10734-006-9018-4

Khoroshko LL and Vikulin MA (2020). Automation of distributing the teaching load to increase the effectiveness of planning of work of the teaching staff. International Journal of Engineering Pedagogy, 10(2): 112-118. https://doi.org/10.3991/ijep.v10i2.11614

Kim S and Nembhard DA (2013). Rule mining for scheduling cross training with a heterogeneous workforce. International Journal of Production Research, 51(8): 2281-2300. https://doi.org/10.1080/00207543.2012.716169

LaVelle JM, Lovato C, and Stephenson CL (2020). Pedagogical considerations for the teaching of evaluation. Evaluation and Program Planning, 79: 101786. https://doi.org/10.1016/j.evalprogplan.2020.101786

Lieharyani DC, Putra PGAP, Ginardi RV, and Sukmono RA (2020). Audit conformity for higher education using good university governance (GUG) principle. In the International Conference on Industrial Engineering and Operations Management, Dubai, UAE: 2081-2089.

Liu D and Findlay MA (2014). Assessment of resource scheduling changes on flight training effectiveness using discrete event simulation. Human Factors and Ergonomics in Manufacturing

and Service Industries, 24(2): 226-240. https://doi.org/10.1002/hfm.20292

Solangi ZA, Al Shahrani F, and Pandhiani SM (2018). Factors affecting successful implementation of eLearning: Study of colleges and institutes sector RCJ Saudi Arabia. International Journal of Emerging Technologies in Learning, 13(6): 223-230. https://doi.org/10.3991/ijet.v13i06.8537

Sonmez R and Uysal F (2015). Backward-forward hybrid genetic algorithm for resource-constrained multiproject scheduling problem. Journal of Computing in Civil Engineering, 29(5): 04014072. https://doi.org/10.1061/(ASCE)CP.1943-5487.0000382

Stewart BD, Webster DB, Ahmad S, and Matson JO (1994). Mathematical models for developing a flexible workforce. International Journal of Production Economics, 36(3): 243-254. https://doi.org/10.1016/0925-5273(94)00033-6