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Management: Statistical Process Control and Quality Control' Tools regarding Measuring Organizations' Quality. The case of Pareto Chart Total Quality

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Abstract

The chief object of this paper is to explore the Pareto principle in relation to higher education quality. Consequently the paper relates to 80/20 rule' application in Greek higher education regarding quality. The study adopted Parasuruman's Servqual dimensions named tangibility, reliability, responsiveness, assurance and empathy and applied the rule. The sample comprised of 202 interviewees from the department of Business Administration in the University of Western Macedonia, of whom 127 (62.9%) were men and 75 (37.1%) were women. The results related to 80 percent or almost 80 percent of each dimension showed their maximized impact.

1. Theoretical Framework

Statistical Process Control (SPC) is a cornerstone of Total Quality Management (TQM). SPC "is an effective problem solving technique used to monitor, control, analyze, manage and improve a process based on statistical methods" (Tsaroucha & Psoma, 2016, p. 49). Process Statistical Control can be defined as "the application of statistical methods for measuring and analyzing variability in process characteristic values" (Georgakakos 2002, p. 22). Process Statistics is a set of processes that use statistical techniques to improve the quality of products or services with the primary goal of validly measuring and analyzing any change in the production process (Mirzaei et al., 2016). Process Statistical Control (STS) provides a wide variety of statistical tools and charts specifically designed to help business or organization executives monitor process status and quickly identify specific causes of variability.

Higher education institutions are looking for quality and excellence in education (Anastasiadou & Zirinoglou, 2015a; Anastasiadou & Zirinoglou, 2015b; Anastasiadou 2015; Anastasiadou & Zirinolou, 2014a; Anastasiadou et al. 2016b; Anastasiadis, 2016; Taraza, & Anastasiadou, 2019a;. Anastasiadou, & Taraza, 2019a). Numerous researches have been made indicating the necessity regarding quality in education (Taraza & Anastasiadou, 2019a; Taraza & Anastasiadou, 2019b; Taraza & Anastasiadou, 2019c; Papadaki, & Anastasiadou, 2019; Papadaki & Anastasiadou, S. 2020; Anastasiadou & Zirinoglou, 2015b; Anastasiadou, 2018c; Anastasiadou & Taraza, 2019b; Anastasiadou & Taraza, 2019c; Anastasiadou et al., 2016b; Anastasiadou, & Taraza, 2020a; Anastasiadou, 2019 and Anastasiadou, & Taraza, 2020b) and for this it is necessary to study with the help of Statistical Process Control (SPC) through the aforementioned statistical tools and charts among which is the Pareto chart.

The Pareto chart is one of the seven basic tools of quality control. The Pareto principle Is the well-known principle of 80/20' rule. It states that for many facts, roughly 80% of the effects come from 20% of the cause. Mathematically, 80/20 rule is roughly followed by a paper law distribution named Pareto Distribution. Pareto analysis is a statistical analysis technique that helps make the right decisions to improve a situation. The present analysis depicts the events based on their frequency of occurrence. In other words, the technique demonstrates the most important causes from which most problems arise. In other words, Pareto analysis validates the major causes of a problem and not all. The Pareto diagram "depicts the contribution of each cause to the final result (problem) and indicates the points that need improvement" (Tsiotras, 2016). Garg & Garg (2013, p. 506) typically state that Pareto analysis "is used by executives to achieve the maximum improvement of processes, functions, etc. pointing out the important causes of a problem from the least important It is an indisputable fact that Pareto chat has been used by many companies and researchers (Craft & Leake, 2002; Fotopoulos et al., 2011; Garg & Garg, 2013; Hammad et al. 2019; Karuppusami & Gandhinathan, 2006q Knights, 2001; Tague, 2004; Talib & Hamid, 2015; Vanteddu &McAllister, 2014).

In the present we adopted Parasuruman's Servqual dimensions named tangibility, reliability, responsiveness, assurance and empathy and applied the rule of Pareto principle.

2. The purpose of the study

The main aim of this paper is to investigate the pareto principle in relation to higher education quality. The Pareto principle states that hardly 20% percent of the action is responsible for 80 percent of its outcome meaning that 80 percent of the impact comes from 20 percent of the Couse. Thus the paper concerns the application of 80/20 rule in Greek higher education regarding quality. The study adopted Parasuruman's Servqual dimensions named tangibility, reliability, responsiveness, assurance and empathy and applied the rule (Parasuraman, et al., 1985; Parasuraman, et al., 1988; Zeithaml et al., 1996). Thus, 80 percent of each dimension is evaluated in order its impact to be maximized.

3. The instrument

In this section, the five dimensions of the Servqual model (Tangibility, Assurance, Reliability, Responsveness and Empathy) were applied at the University of Western Macedonia and formed the basis of the Statistical Process Control released by Pareto Chart. In detail, the five dimensions of the Servqual model in educational contexts are presented below:

The first category of questions is Tangibility (concerning infrastructure, facilities, equipment and staff appearance) and consists of the questions coded as Teacher_App, Classrooms, Lighting, Buliding, Cleanliness, Comfortable, Decoration, Stuff_App, Parking, Curriculum, Number_c, Comp_add, Up_comput, Up_software, , Access and Culture (e.g. Teacher_App: Appearance of Lecturers, Classrooms: Layout of classrooms, Lighting: Lighting in classrooms, Buliding: Appearance of building and grounds, Cleanliness: Overall cleanliness, Comfortable: Degree to which classrooms and study rooms are comfortable, Decoration: Decoration and atmosphere, Stuff_App: Appearance of personnel, Parking: Available of parking, Curriculum: The degree to which curriculum is up to date, Number_c: Number of courses offered, Comp_add: Computers adequacy provided in the lab for students, Up_comput: Up-to-datedness' of computers, Up_software: Up-to-datedness' of software used in computers, Access: Access to the Internet/e-mail, Culture: The organizational culture, belief and value in this university).

The second category of questions is Assurance and concerns the knowledge, the courtesy of the staff (administrative and teaching) and their ability to inspire confidence. This category consists of the questions coded as Frie_staff, Frie_teach, Efficiency, Acad_cred, Innovative, Community, Procedures, Security, Co_skills (e.g.

Frie_staff: Friendly and courteous university staffs, Frie_teach: Friendly and courteous lecturers, Efficiency: Lecturers research efficiency/productivity, Acad_cred: Academic credentials of lecturers, Innovative: Lecturers are innovative and agents of change, Community: The degree to which university involve with the community, Procedures: University's staffs knowledge on rules and procedures, Security: Security measures at your university and Co_skills: Communication skills: courses are well taught by the lecturers in this University).

The third category of questions is Reliability and concerns the ability to perform the promised service accurately and reliably by the university staff. The Reliability category consists of the questions coded as Error_free, Accurately, Reliability, Staf_interest, Promises, Proficiency, Teac_interest (e.g. Error_free: Registration is timely and error-free, Accurately: This university keeps its records accurately, Reliability: The general reliability of lecturers ie. keeps time/don't cancel classes, Staf_interest: Staff sincere interest in solving student's problem, Promises: This university provides its services at a time it promises to do so, Proficiency: Teaching capability of lecturers/proficiency and Teac_interest: Lecturers sincere interest in solving student's problem).

The fourth category of questions is Responsiveness and concerns the willingness of staff to help students and provide prompt service. This category consists of the questions coded as Person_avail, Lectur_avail, Lectur_capab, Person_capab, Information, Channels, Querirs_Prom (e.g. Person_avail: Availability of personnel to assist you, Lectur_avail: Availability of lecturers to assist you, Lectur_capab: Lecturers capacity to solve problems when they arise, Person_capab: Staffs capacity to solve problems when they arise, Information: I seldom get the "run-around" when seeking information on this University, Channels: Channels for expressing student complaints are readily available and Querirs_Prom: Queries are dealt with efficiently and promptly).

The fifth category of questions is Empathy and concerns the provision of care and personalized attention to students / parents, etc. This category consists of questions coded as Admin_inter, Room_accom, Comp_facilit, Attention, Lect_sympat, Comp_rumes and Fair (Admin_inter, Room_accom, Comp_facilit, Attention, Lect_sympat, Comp_rumes and Fair).

The reliability of the instrument was related to items 1 to 46 was estimated by Cronbach alpha coefficient (a). The value of Cronbach's α coefficient for this instrument was

equal to 0.871 and it is a very high value in terms of internal consistency (Alevriadou et al., 2014; Anastasiadis, 2020; Anastasiadou, 2007; Anastasiadou, 2008; Anastasiadou, 2009; Anastasiadou et al., 2010b; Anastasiadou, 2011; Anastasiadou, 2012; Anastasiadou, 2013a, Anastasiadou, 2013b; Anastasiadou, 2013c; Anastasiadou, 2018b; Anastasiadou, 2018c; Anastasiadou, 2018d; Anastasiadou, 2018e; Anastasiadou, 2019a; Anastasiadou 209b; Anastasiadou & Anastasiadis, 2011; Anastasiadou & Anastasiadis, 2019; Anastasiadou et al., 2016; Anastasiadou & Karakos, 2011; Anastasiadou & Kofou, 2013a; Anastasiadou & Kofou, 2013b; Anastasiadou & Pappa, 2009; Anastasiadou & Pappa, 2019; Anastasiadou & Loukas, 2009; Anastasiadou & Taraza, 2019; Anastasiadou & Taraza, 2020a; Anastasiadou & Taraza, 2020b; Anastasiadou et al., 2014; Florou, et al., 2015; Kofou, & Anastasiadou, 2013; Souravlas & Anastasiadou, 2020; Souravlas et al., 2020; Thapa et al., 2016; Theodoridou, et al., 2014).

The Cronbach' alpha coefficient is calculated to measure the reliability of the five dimensions, i.e. Tangibility, Assurance, Reliability, Responsiveness and Empathy (Table 1). Cronbach' alpha coefficient verified the reliability of the instrument SERVQUAL. In additions Cronbach' alpha coefficient (α) was above the cutoff point of 0.70 for all the dimensions of SERVQUAL instrument (Table 1).

Table 1: Cronbach's Alpha of all the items

Dimensions	**Cronbach's Alpha**
Tangibles	0.765
Assurance	0.843
Reliability	0.792
Responsiveness	0.801
Empathy	0.838
Total Scale	0.871

4. Profiles of the respondents

The demographic profiles includes the following characteristics of the despondences; gender, age and year of education. The demographic profiles shown in Table 1 is based on frequency and relative frequency distributions.

The sample comprised of 202 interviewees from the department of Business administration in the University of Western Macedonia, of whom 127 (62.9%) were men and 75 (37.1%) were women. With respect to the ages of participants, 138 (68.3%)

of them were 18 years old, 28 (13.9%) of them were 19 years old, 9 (4.5%) of them were 20 years old and, finally, 28 (13.4%) were 21 years or more. With respect to their year of studies, 138 (68.3%) of them were during their first year of their studies, 28 (13.9%) of them were during the second year, 9 (4.5%) of them were during the third year 16 (7.9%) of them were during the fourth year and 11 (5.4%) of them were during the fifth year and above (Table 2).

Table 2: Demographic data of the sample (N = 202)

Variables	**Classes**	**N=202**	**%**
Gender	Male	127	62.9
	Female	75	37.1
Age	18 years	138	68.3
	19 years	28	13.9
	20 years	9	4.5
	21 years or more	28	13.4
Year of Studies	First year	138	68.3
	Second year	28	13.9
	Third year	9	4.5
	Fourth year	16	7.9
	Fifth year and above	11	5.4

Results

Tangibility Results: From the table 3 and figure 1 it is evidence that the variables 'The degree to which curriculum is up to date', 'Number of courses offered', 'Computers adequacy provided in the lab for students', 'Overall cleanliness', 'Up-to-datedness' of computers', ''Up-to-datedness' of software used in computers', 'Access to the Internet/e-mail' and Appearance of building and grounds' count for the 78,2% value towards Tangibility (Table 3).

Table 3: Tangibility Results

Tangibility				
Items	Frequency	Percent	Valid Percent	Cumulative Percent

Curriculum: The degree to which curriculum is up to date	46	22,8	22,8	22,8
Number_c: Number of courses offered	32	15,8	15,8	38,6
Comp_add: Computers adequacy provided in the lab for students	19	9,4	9,4	48,0
Cleanliness: Overall cleanliness	17	8,4	8,4	56,4
Up_comput: Up-to-datedness' of computers	14	6,9	6,9	63,4
Up_software: Up-to-datedness' of software used in computers	14	6,9	6,9	70,3
Access: Access to the Internet/e-mail	8	4,0	4,0	74,3
Building: Appearance of building and grounds	8	4,0	4,0	78,2
Comfortable: Degree to which classrooms and study rooms are comfortable	7	3,5	3,5	81,7
Culture: The organizational culture, belief and value in this university	7	3,5	3,5	85,1
Classrooms: Layout of classrooms	6	3,0	3,0	88,1
Lighting: Lighting in classrooms	6	3,0	3,0	91,1
Teacher_App: Appearance of Lecturers	6	3,0	3,0	94,1
Parking: Available of parking	5	2,5	2,5	96,5
Decoration: Decoration and atmosphere	5	2,5	2,5	99,0
Stuff_App: Appearance of personnel	2	1,0	1,0	100,0
Total	202	100,0	100,0	

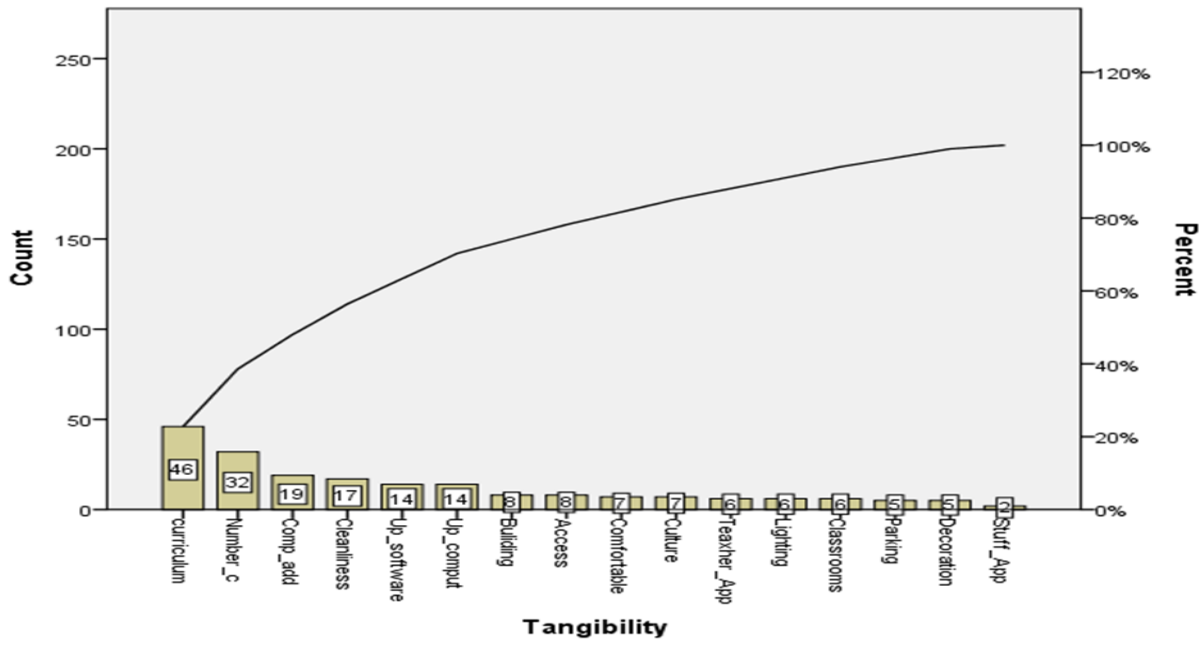

Figure 1: Tangibility

Assurance Results: From the table 4 and figure 2 it is evidence that the variables 'Lecturers research efficiency/productivity', 'Communication skills: courses are well taught by the lecturers in this University', 'Lecturers are innovative and agents of change', 'Academic credentials of lecturers',' Security measures at your university' count for the 78,7 % value towards Assurance (Table 4).

Table 4: Assurance Results

Assurance				
Items	Frequency	Percent	Valid Percent	Cumulative Percent
Efficiency: Lecturers research efficiency/productivity	68	33,7	33,7	33,7
Co_skills: Communication skills: courses are well taught by the lecturers in this University	32	15,8	15,8	49,5
Innovative: Lecturers are innovative and agents of change	28	13,9	13,9	63,4
Acad_cred: Academic credentials of lecturers	17	8,4	8,4	71,8
Security: Security measures at your university	14	6,9	6,9	78,7
Community: The degree to which university involve with the community	12	5,9	5,9	84,7
Frie_staff: Friendly and courteous university staffs	11	5,4	5,4	90,1
Procedures: University's staffs knowledge on rules and procedures	11	5,4	5,4	95,5
Frie_teach: Friendly and courteous lecturers	9	4,5	4,5	100,0
Total	202	100,0	100,0	

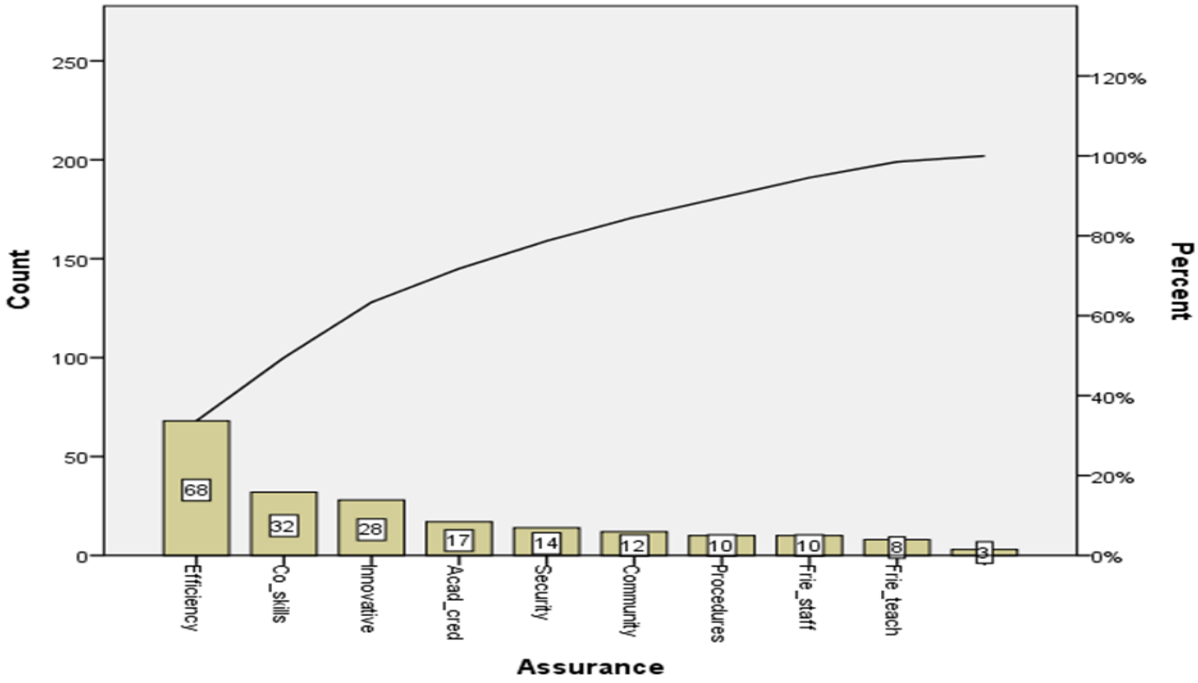

Figure 2: Assurance

Reliability Results: From the table 5 and figure 3 it is evidence that the variables 'Teaching capability of lecturers/proficiency', 'The general reliability of lecturers ie. keeps time/don't cancel classes', 'Lecturers sincere interest in solving student's problem', 'This university provides its services at a time it promises to do so' count for the 80,7 % value towards Reliability.

Table 5: Reliability Results

Reliability				
Items	Frequency	Percent	Valid Percent	Cumulative Percent
Proficiency: Teaching capability of lecturers/proficiency	69	34,2	34,2	34,2
Reliability: The general reliability of lecturers ie. keeps time/don't cancel classes	56	27,7	27,7	61,9
Teac_interest: Lecturers sincere interest in solving student's problem	19	9,4	9,4	71,3
Promises: This university provides its services at a time it promises to do so	19	9,4	9,4	80,7
Staf_interest: Staff sincere interest in solving student's problem	17	8,4	8,4	89,1

Accurately: This university keeps its records accurately	12	5,9	5,9	95
Error_free: Registration is timely and error-free	10	5,0	5,0	100,0
Total	202	100,0	100,0	

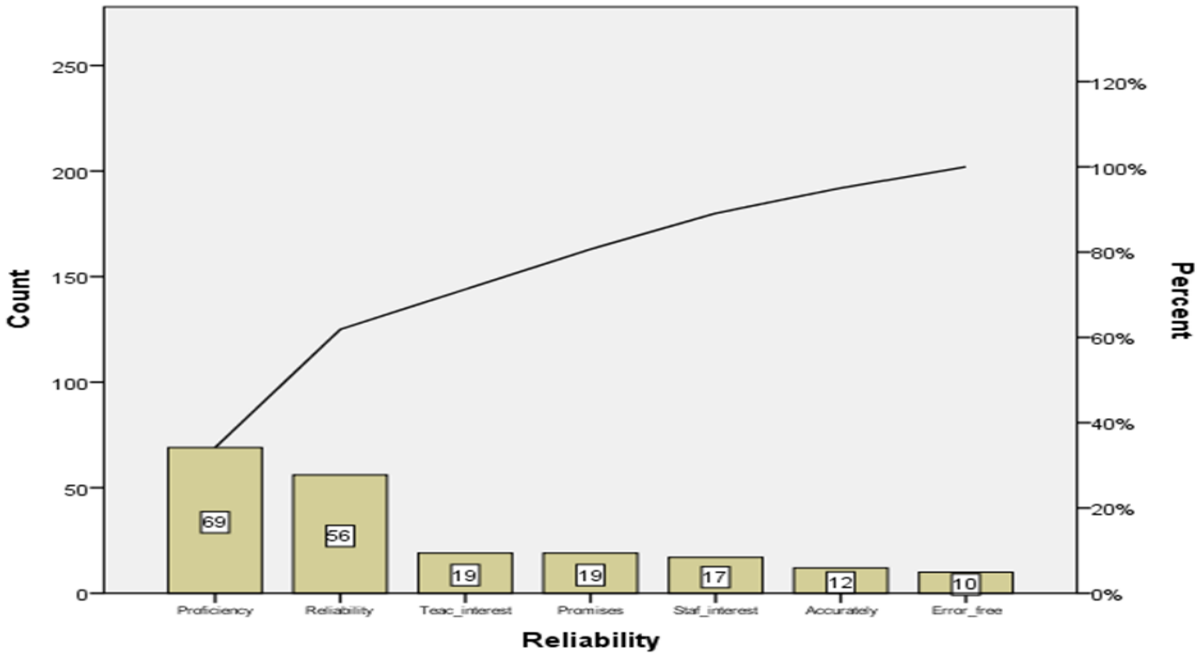

Figure 3: Reliability

Responsiveness Results: From the table 6 and figure 4 it is evidence that the variables 'Availability of lecturers to assist you.', 'Lecturers capacity to solve problems when they arise', 'Staffs capacity to solve problems when they arise', 'Queries are dealt with efficiently and promptly' count for the 81,7 % value towards Responsiveness (Table 6).

Table 6: Responsiveness Results

Responsiveness				
Items	Frequency	Percent	Valid Percent	Cumulative Percent
Lectur_avail: Availability of lecturers to assist you	88	43,6	43,6	43,6
Lectur_capab: Lecturers capacity to solve problems when they arise	37	18,3	18,3	61,9
Person_capab: Staffs capacity to solve problems when they arise	20	9,9	9,9	71,8

Querirs_Prom: Queries are dealt with efficiently and promptly	20	9,9	9,9	81,7
Person_avail: Availability of personnel to assist you	13	6,4	6,4	88,1
Channels: Channels for expressing student complaints are readily available	13	6,4	6,4	94,6
Information: I seldom get the "run-around" when seeking information on this University	11	5,4	5,4	100,0
Total	202	100,0	100,0	

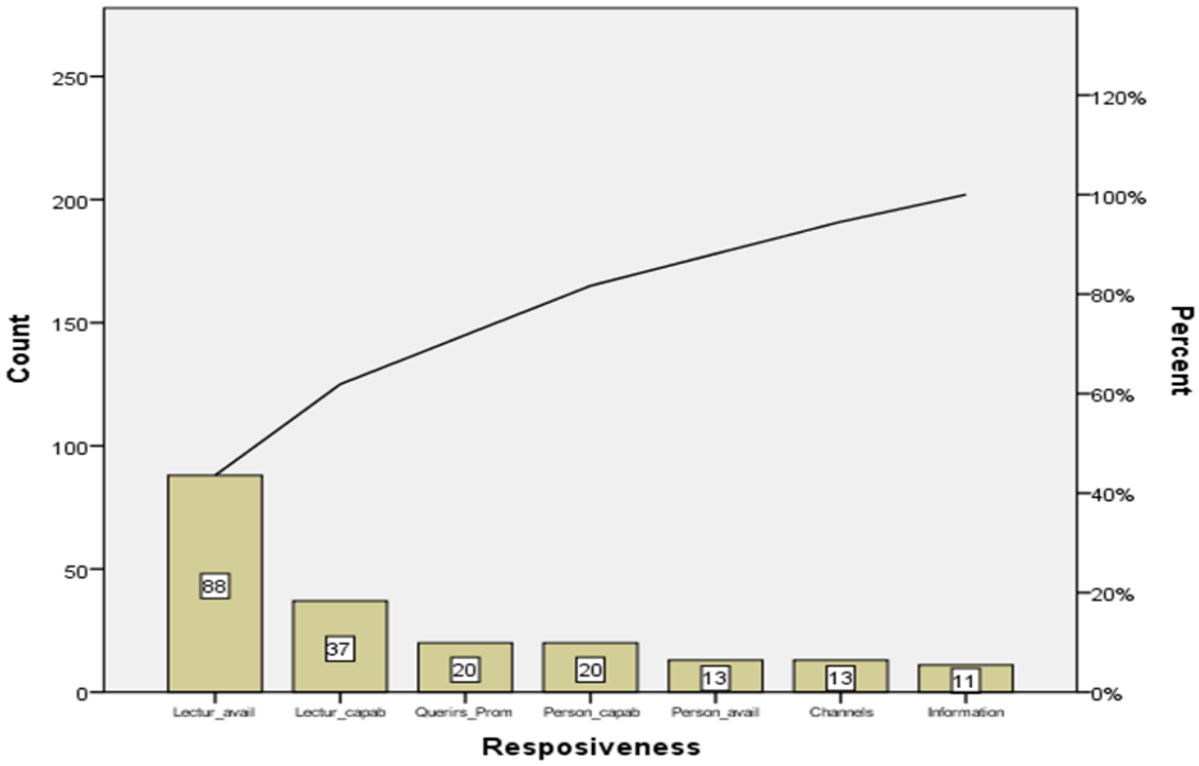

Figure 4: Responsiveness

Empathy Results: From the table 7 and figure 5 it is evidence that the variables 'University are fair and unbiased in their treatment of individuals students', 'Administration has students' best interest at heart', 'Opening hour of computer rooms to the students', 'Access to study rooms is accommodate with students' convenient' count for the 86,6 % value towards Empathy (Table 7).

Table 7: Empathy Results

Empathy				
Items	Frequency	Percent	Valid Percent	Cumulative Percent
Fair: University are fair and unbiased in their treatment of individuals students	83	41,1	41,1	41,1
Admin_inter: Administration has students' best interest at heart	40	19,8	19,8	60,9
Comp_rumes: Opening hour of computer rooms to the students	28	13,9	13,9	74,8
Comp_facilit:Access to study rooms is accommodate with students' convenient	24	11,9	11,9	86,6
Room_accom41 Access to computer facilities is accommodate with students' convenient	12	5,9	5,9	92,6
Lect_sympat The extent to which lecturers are sympathetic and supportive to the needs of students	8	4,0	4,0	96,5
Attention43 Staff are willing to give students individual attention	7	3,5	3,5	100,0
Total	202	100,0	100,0	

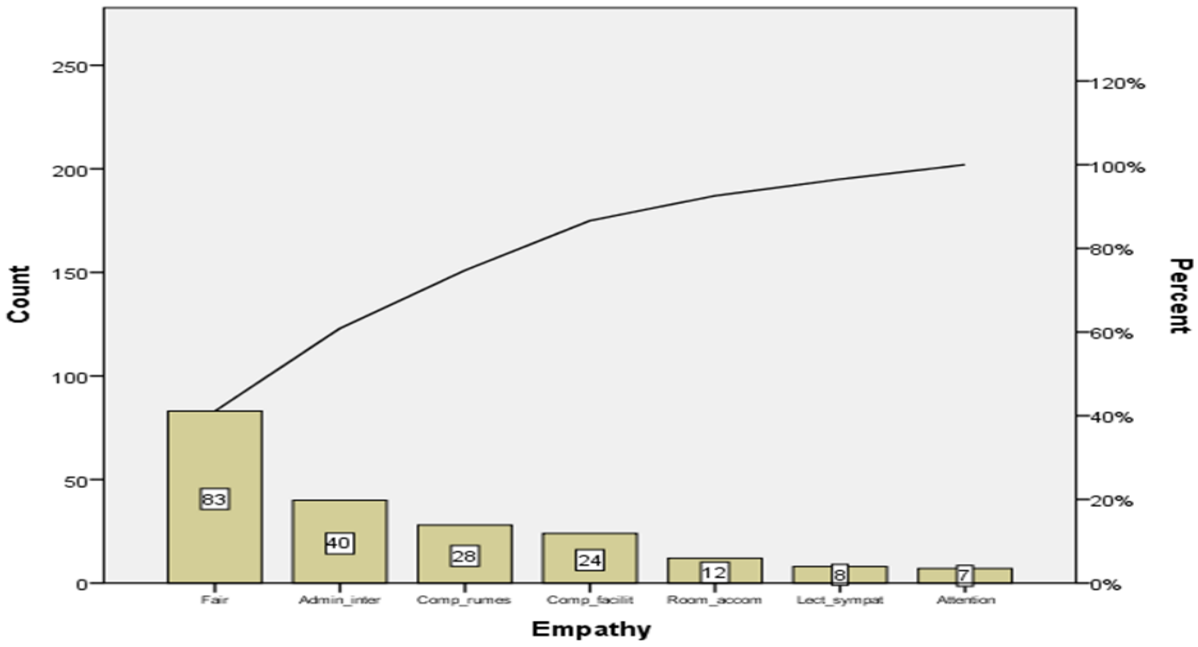

Figure 4: Empathy

Conclusions

The topmost purpose of the current study is to walk around the Pareto principle in relation to higher education quality. Consequently the paper relates to 80/20 rule' application in Greek higher education regarding quality based on 202 interviewees from the department of Business Administration in the University of Western Macedonia. These students responded Parasuruman's Servqual scale.

The results indicate that regarding the Tangibility dimension respondents claimed that the most important parameters are the datedness of curriculum as well as the number of courses offered added to the computers adequacy provided in the lab for students. Furthermore the parameters referring to Overall cleanliness, 'Up-to-datedness' of computers and software used in computers along with Access to the Internet/e-mail and Appearance of building and grounds are also important.

The fallouts specify that apropos the Assurance dimension respondents claimed that the most key considerations are lecturers research efficiency/productivity, the well taught courses by the lecturers at the University innovative lectures and agents of change, lecturers academic credentials besides university security measures.

The outcomes signpost that on the topic of the Reliability dimension respondents claimed that the most important parameters are lectures' teaching capability and proficiency in companion with the general reliability of lecturers regarding classes' cancelation and lesson duration. Furthermore the parameters connected with lecturers' sincere interest in solving student's problem and university services provision at a time it promises to do are also significant.

The results indicate that regarding the Responsiveness dimension what count most for the responses are the availability of lecturers to assist students as well as lecturers capacity to solve problems when they arise. Still the parameters referring to Staffs capacity to solve problems when they arise and queries that dealt with efficiently and promptly are essential.

Finally, the results point out that regarding the Empathy dimension what count most for the responses are connected with the degree the university is fair and unbiased toward all the students other than the degree that Administration has students' best interest at

heart. In addition factors regarding opening hour of computer rooms to the students and access to study rooms is accommodate with students' convenient are crucial.

Still a lot of research has to be done in order Greek tertiary education to achieve excellence and keep students, their parents, society, market, and relative stakeholders satisfied.

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